ERRATA

Page 415: *Insert after "The proportions of the various ingredients composing the Bituminous Concrete shall be as follows:"*

Bitumen 7-9 per cent.

Page 587: *Insert after Collins, Geo. R.*, Continental Public Works Co., 2 Rector St., New York. W. B. Spencer, President.

Page 595: *Insert after Spencer, Herbert*, Spencer, W. B. Pres. Continental Public Works Co., 2 Rector St., New York.

PROCEEDINGS

OF THE

Twenty-Second Annual Convention

OF THE

American Society of Municipal Improvements

HELD AT

DAYTON, OHIO

OCTOBER 12, 13, 14 and 15, 1915

INDIANAPOLIS
CHARLES CARROLL BROWN, Secretary
702 WULSIN BUILDING
1916

THE 1916 CONVENTION WILL BE HELD AT THE NEW ROBERT TREAT HOTEL, NEWARK, N. J. OCTOBER 9, 10, 11, 12, 13

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PAPERS AND DISCUSSIONS

GARBAGE DISPOSAL IN DAYTON, OHIO.

By J. E. BARLOW, Director of Public Service.

The problem of the collection and disposal of garbage has been one of the most vexatious ones we have had to face in Dayton. The questions of separate or combined collection, the method of disposal to be adopted, and last, but not least, the locations of loading stations, if used, and of the plant, are all problems which have to confront one to be fully appreciated.

The correct economic solution is a matter of local conditions—in other words, what is best for one city may not be so for another. The method to which residents have become accustomed has also an important bearing.

It is not my purpose to go into a technical discussion of garbage collection and the relative merits of various methods of disposal, but rather to relate how the problem confronted the City of Dayton on January 1st of last year and what has been done in an effort to solve it.

Prior to 1914, the garbage, required by ordinance to be placed in separate receptacles, had been collected by the city and delivered to a privately owned Reduction Plant which disposed of it without compensation under a ten-year contract which expired December 23rd, 1913. This arrangement proved hardly satisfactory as the Reduction Company claimed that it did not get all of the garbage, the best being collected by private scavengers and that the city allowed the householders to put in too much water and rubbish. The Reduction Company sued the city and obtained judgment for $30,500.00. Dayton's experience in this matter gives substantial testimony to the desirability of having the authority and responsibility for the collection, disposal and enforcement of the ordinances requiring proper separation of the garbage, concentrated—all of which leads to municipal ownership.

Just before the expiration of the above mentioned contract, the city after having received and rejected bids several times, again received bids for a contract covering both collection and disposal of the

garbage to take effect December 23rd, 1913, but awarded no contract. When the operation of the city under the charter took effect in January, 1914, the time for the beginning of the contract had lapsed and furthermore, a legal question was raised as to the power of the city to let a contract for a service extending over a period in excess of one year without all the money for the full term of the contract being in the fund. This resulted in the rejection of all the bids.

The City then employed the firm of Hering and Gregory, Sanitary Engineers, of New York City, to make an investigation and report on the whole subject of collection and disposal of the city's wastes, including ashes, rubbish, garbage and manure. A comprehensive report was made in March, 1914, recommending a combined collection and an incinerating plant. Careful consideration was given to this report but with so many problems requiring large expenditures facing the ctiy, it was felt that the city could not at present undertake the recommended plan.

In the meantime, the old reduction company continued to receive and dispose of the city's garbage, which arrangement continued until June, 1914. The Reduction Company then notified the city that the cost of repairs to the plant was excessive and that they would require a payment of $500 per month to continue further. In the meantime, constant and strenuous complaints from neighboring residents were received, protesting against the odors emanating from the plant. Confronted with the above situation, some temporary expedient had to be adopted and burial of the garbage was resorted to. To thus dispose of the garbage from a population of 130,000 people sounds a rather formidable proposition, but it has proved comparatively easy and quite satisfactory. The site selected for the burial ground was an old gravel pit alongside the railroad tracks north of the city. The garbage is shipped out in gondola cars and there unloaded and covered over with gravel by workhouse prisoners. Several "knights of the road" who were temporary guests at this city institution and who were used on this work, threatened to give the ctiy of Dayton a wide berth in their future wanderings and so this method may effectively dispose of nuisances other than garbage.

This method of disposal will continue to be used until the new plant is in operation.

As stated before, the city had several times during 1913, taken bids on a contract covering both the collection and disposal of the city's garbage. In each case Stephen E. Wilson, who had had wide experience in the construction and operation of reduction plants had been the low bidder. The bids submitted by Mr. Wilson had appeared to be very reasonable and several conferences were held with him in which the type and cost of the plant which he had proposed to erect, were discussed. Finally, in the latter part of last year, it was decided to employ Mr. Wilson to design for the city and superintend the construction of a reduction plant such as he had intended to build for himself and to him is due the design of the plant which is now nearing completion.

In adopting the reduction method of disposal we do not believe that the profits will run the city without taxation—we do believe, however, that the plant can be easily made entirely self-supporting, i. e., the revenue from the grease and tankage will pay all the plant operating and investment charges but will not pay for the collection. In other words, the city will not be put to any expense for the disposal of its garbage and valuable by-products will be conserved. This is based on the following estimates:

Population—Dayton, 1914	130,000
Production of garbage per year (based on .09 ton per capita per year)	11,700 tons
Production of grease at 3%	351 tons
Production of tankage at 11%	1,287 tons
Estimated yearly value of grease at $70 per ton	$24,570
Estimated yearly value of tankage at $6 per ton	7,722
Estimated total year's revenue	$32,292.
Estimated complete cost of Plant including land, sidetrack, etc.	$55,000
Estimated yearly operating expenses	$25,000
Estimated investment charge at 10% gross	$ 5,500

This estimate thus shows a narrow margin of profit amounting to about $1,800 per year.

There is no allowance made for taxes nor for freight on the garbage to the plant.

The above estimates are believed to be very conservative. It is realized, of course, that there is some hazard involved. "Hard

times" and "high cost of living" are reflected in a reduced qua of grease in the garbage. The price of grease and tankage fluctu The present war has upset the market for grease. Nevertheless believe, under local conditions, that the reduction process was proper method to be adopted. A recent report of the Colun plant shows for 1914 a gross revenue of $3.08 per ton of garl and an operating expense of $1.86 per ton. Our estimates, not exactly comparable, show a revenue of $2.76 per ton and operating expense of $2.14.

The site finally selected for the reduction plant is located on C. H. & D. R. R. about seven miles below the city. Two tra of land were purchased, one covering an area of about six acres which the plant proper is located and the other a tract of abo thirty-two acres of low land lying between the plant and the rive A sidetrack about 2,000 feet long has been constructed into tl plant.

The general layout of the plant is shown in the accompanyin drawings. The type of reduction equipment adopted is what migh be called the cooking, pressing, drying and percolating process.

The capacity of the plant will be fifty tons of garbage per da with one eight-hour shift. The capacity, however, with continuou operation would be about 125 tons per day. This would make the total cost of the plant about $440 per ton of capacity.

The buildings are of one story with the exception of the digester building, and are of concrete having steel roof supports with wooden covering. They are not showy as your brief inspection will show you tomorrow, but they are substantial and substantially fireproof.

The lowest floor is about 10 feet below the height of the 1913 flood. The damage that can be done to the plant by high water is not serious and it was felt that the expense necessary to raise the grade of the whole ravine would not be justified. The flood prevention plans will also greatly reduce the maximum flow of the river.

The general process of reduction is doubtless known to most of you, but I will run over the various steps in the complete handling of the garbage locally.

The collections at present are made in large iron boxes which are taken bodily from the wagons and loaded at the loading station on flat cars, owned by the city, on which the tanks are shipped to the plant.

In passing I would state that garbage, except in the business section of the city, is only collected once per week. This costs about $22,000 per year. It is, of course, our intention, if money can be secured, to collect more frequently, which incidentally would improve the quality of the garbage for reduction purposes.

The garbage boxes will be taken from the flat cars at the plant by means of a crane and dumped in the receiving pit. Some saving could be effected by the use of special garbage dump cars but this would also involve questions at the loading station and likely relocation of same. This green garbage pit has a sloping side from the track down to the conveyor so that a man can readily rake the garbage onto the conveyor and at the same time pull out any large foreign materials. The garbage is spouted from the conveyor to the digesters—there are ten of these vertical tanks, each holding five tons. There is room in the digester building for the installation of two more tanks.

After cooking with live steam at about 65-75 pounds pressure, the cooked garbage is pressed by means of live steam so that the cooked garbage contains 55%-65% moisture.

The pressed tankage is then taken by means of two conveyors and a cross conveyor from the digesters to the direct fire dryer. This fire dryer differs from the ordinary dryer in that the feed end is at the cooler end of the dryer. It is believed that better results will be secured with less loss of material thru burning. There is also a device for controlling the temperature by means of induced draft of air.

The tankage after drying is conveyed from the dryer to the percolator where it is treated with gasoline to remove the grease. The percolator is of the horizontal, revolving type and has a capacity of about 6 tons.

A small dryer is provided for re-drying the tankage should any moisture be absorbed in the percolating process. The gasoline and grease in the washings from the percolator are separated by distilling off the gasoline which is, of course, condensed and used over again.

The power plant consists of three 80-h. p. horizontal tubular boilers. All the machinery will be motor-driven, power being purchased from the local power company. The full connected load will only be about 68 h. p.

One deep eight-inch well has been driven from which we expect to get an amply supply of water for the operation of the plant. Should continuous pumping prove this supply inadequate, the river, close by, offers an inexhaustible supply. This well water is very cold and hence will be especially good for use in condensing vapors and gases from the settling boxes, digesters and dryers. This is being relied upon for the control of odors rather than burning the gases, which latter may result merely in spreading the unburned odorous gases broadcast.

Although some claim is made that it is profitable to install evaporators and thus recover the so-called "stick," it is not our intention to do so. Instead, it is planned to allow this tail water to flow over our thirty-two acre tract of land which is underlain with gravel and which will be planted to corn and other crops and thus secure the benefits of whatever fertilizer ingredients it may have.

The features in which this plant differs from others are the general arrangement of low separated buildings of substantial construction, the receiving pit, the novel direct fire dryer, the layout of the equipment and the low cost of the plant entire. It is, in fact, a contractor's plant built for economical operation. However, time alone will now prove the merits or demerits of the design.

Discussion of this paper will be found on page 27.

GARBAGE COLLECTION AND DISPOSAL.

By B. F. MILLER, City Engineer, Meadville, Pa.

The writer is frank to confess that the above title to this paper was suggested more by what he hoped the paper would contain, rather than by its present contents. When Mr. J. T. Fetherston, chairman of the committee on "Garbage Disposal and Street Cleaning," asked him to prepare a paper for the Dayton convention, even tho it was late in August, the writer was optimistic enough to believe that he could collect some valuable data and incorporate it into a paper which would prove of interest to the members of the society. In common with Mr. William F. Morse, of New York City, and also the Bureau of Municipal Research of the same city, who had separately attempted to collect data on garbage disposal, the results in this case, as in the other two, were somewhat disappointing. In fact, there seems to be a very noticeable lack of interest among municipalities in the keeping of intelligent and reliable accounts, in this branch of municipal activity. This may be due to several causes, one of which may be that, (especially in reduction plants), many plants are privately owned and operated and, therefore, records are not available. Then again in many cities the incinerators are under the control of the local departments of health, to whom operating costs are, perhaps, not as vital, as the public health. Then, too, in the matter of collection, much is done by contract and there is no means of ascertaining reliable cost data, the companies not being willing to furnish such information.

The writer is hopeful that enough interest will be created, perhaps by discussion of this paper, which will lead to the adoption of a simple form of recording data on this important subject, which can be tabulated and be made available for the use of the members of this society and others. He would suggest that this committee send out yearly to all municipalities, a form of question blank relative to garbage disposal statistics, and that these statistics be tabulated and published in the proceedings of the society.

During the last thirty days the writer sent out a list of twenty-one questions, relative to the subject in hand, to one hundred and twenty-four cities, all over fifty thousand population. To date sixty-one replies have been received, or just about fifty per cent. Excellent

reports were obtained from Cleveland, Milwaukee and Savannah. The report of Cleveland was especially fine in the matter of cost analysis for garbage reduction and collection, also for ash and rubbish removal. Much valuable data could have been obtained, no doubt, by correspondence with cities under fifty thousand, but the time given was too short. The data obtained will be tabulated and printed as a part of this paper. Some additional data were obtained from a paper by William F. Morse, read before the American Public Health Association, making over seventy cities heard from.

Below are noted some of the most interesting facts, which are apparent from the answers received.

Reduction.

William F. Morse, sanitary expert, says that reduction is not profitable nor economical in cities of less than 75,000 population, or where the quantity of garbage delivered is less than twenty-five tons daily. Methods now in use are more efficient, sanitary and profitable than formerly. Of the seventy-one cities heard from, thirty-one use the reduction system of garbage disposal, and only seven cities own their own plants. Chicago's municipal plant last year cost $144,744.26 over and above all revenue derived from the sale of dry garbage. Cleveland has been able to keep its net cost of combined collection and reduction to $1.89 per ton, $4.90 being the gross cost. Columbus, Ohio, reports a net revenue from its plant. Springfield, Mass. has an option to purchase its reduction plant in ten years for $50,000, or get it free of cost in twenty years. Wilmington lets a contract for collection and reduction, and will own its own plant in nine years. Rochester, N. Y., pays $77,500 yearly to have its garbage collected and reduced. Ten cities report local nuisances arising from reduction plants, while there are, no doubt, many where nuisances exist which were not reported. Reduction costs reported vary from $2.16 gross per ton of garbage in Cleveland to $4.40 in Schenectady. From current news items, seven cities are now either building or considering reduction plants.

Incineration.

There are no incinerators reported in use in cities of over 500,000 population, but Chicago is now building an incinerator for the destruction of combined rubbish and garbage. Twenty-one of the

cities report having incinerators of various types. All are municipally owned. St. Paul, Minn., has had recommended the building of an incinerator with a utilization plant. Savannah's destructor, (described in another paper) utilizes heat, as do also Milwaukee, Minneapolis and Seattle. Duluth is now making a study of municipal collection and incineration. From current news items, more than forty cities are now building or considering building incinerators, in addition to the ones already in operation. The cost per ton for incineration reported, varies from 34 cents per ton in Portland, Oregon, to $2.99 in Spokane. There is probably a wide variation in the elements which make up the reported cost, some cities figuring labor cost only, others labor and fuel, still others labor, maintenance, interest and depreciation; so that the cost per ton in but very few cities, includes all of the same items.

Feeding to Pigs.

Thirteen cities report feeding their garbage to pigs. Cambridge, Mass., realizes $15,000 yearly from the sale of its offal to farmers. The president of the Board of Public Works in Los Angeles, which is now disposing of its garbage for 51 cents per ton to a private reduction company, openly advocates feeding to hogs, claiming that it can be successfully done and that the city can get $2 per ton for its garbage, by selling it to farmers. Denver has its garbage collected free of cost by a hog growers association. Grand Rapids receives 45 cents per ton f. o. b. cars for its garbage. Lawrence, Mass., receives $3,000 yearly for its garbage.

Berkeley and Oakland, Cal., dump their garbage at sea, twenty miles out from shore; three cities bury their garbage; and four cities dump their combined garbage and rubbish on tide water marshes.

Very few reliable data are available on garbage collection. All sorts of methods and equipment are in use. There is much room for improvement in the design of wagons which will prevent the nuisances which arise from the average garbage wagon. Commissioner Fetherston of New York City is doing some excellent work along this line and much is hoped for from his experiments in the matter of garbage containers and wagons. Owing to the fact that many plants have no means of weighing the refuse, the cubic yard is suggested as a unit of measurement for cost reports. The average haul should also be reported. Collection costs reported for gar-

TABLE I—COLLECTION OF GARBAGE

City	By whom collected?	Who pays for collection?	Is garbage separated?	Is garbage wrapped?	Does city collect ashes?	Cost of collection	Average haul	Have you standard size can?	Type of Wagon	Wages of Operators	Collect front or rear
Population Over 1,000,000.											
Philadelphia	Contract	City	No	No	Yes	......	......	......	......	......	......
Chicago	City	Gen. tax	Yes	No	Yes	0.62	3 m	10 & 30 gal.	4 y. steel	$6.00*	Rear
Population 500,000 to 1,000,000.											
Boston	Contract & city	City	Yes	No	......	......	......	......	......	......	......
Cleveland	City	City	Yes	No	Yes	0.71	......	No	......	$2.50	Rear
Pittsburgh	Contract	City	Yes	No	No	2.25	3 m.	Yes	Steel	......	Rear
St. Louis	City	City	No	No	No	......	......	Yes	......	......	......
Population 300,000 to 500,000.											
Los Angeles	City	Gen. tax	Yes	No	Yes	......	......	No	3-ton truck	$2.50	......
Milwaukee	City	Gen. tax	Yes	Yes	Yes	2.75	3.5 m.	Yes	2-y. 1-h. cart	......	Rear
Minneapolis	City	Gen. tax	No	Yes	No	......	......	Yes	3-y. steel	$2.50	Rear
Newark	Contract	City	Yes	No	Yes	.70	2 m.	Yes	6-y. dump	......	Rear
New Orleans	City	Gen. tax	Yes	No	Yes	1.30	1.5 m.	No	1½-y. dump	$3.00	Either
San Francisco	Contract	City	......	......	......	......	......	......	......	......	......
Seattle	City	City	No	No	Yes	1.85	3 m.	Yes	......	......	Rear
Washington, D. C	Contract	City	Yes	No	Yes	0.46	......	Yes	4-y. dump	......	Rear
Population 100,000 to 300,000.											
Albany, N. Y	Contract	City	Yes	No	No	......	......	Yes	3½-y.	......	Rear
Bridgeport, Conn	Contract	City	Yes	No	No	......	......	Yes	Metal	......	Rear
Cambridge, Mass	City	City	Yes	No	Yes	0.34 y.	......	No	6-y.	$2.50	Rear
Dayton, O	City	City	Yes	No	Yes	0.375	......	Yes	5-y	$2.50	Rear
Denver, Colo	Private	No chg.	......	......	No	......	......	Yes	......	......	Alley
Grand Rapids, Mich	City	City	Yes	No	No	......	......	Yes	3 or 4-y.	$2.25	Rear
Hartford, Conn	Farmers	City	Yes	No	Yes	0.35	1 m.	No	4½-y.	$2.50	Rear
Indianapolis, Ind	Contract	City	......	......	Yes	......	......	......	......	......	......
Portland, Ore	Contract	Tenant	No	No	No	......	......	No	Farmers	......	Rear
Providence, R. I	Contract	City	Yes	No	No	......	......	No	......	......	Rear
Reading, Pa	City	City	No	No	No	......	......	Yes	9-y.	$2.50	Curb
Rochester, N. Y	Contract	City	Yes	No	......	0.88	2 m.	......	5-y.	$2.00	Rear
Trenton, N. J	City	City	Yes	Yes	Yes	0.35	1.5 m.	Yes	3-y. dump	$2.33	Curb
Paterson, N. J	Contract.	City	Yes	No	Yes	......	......	Yes	......	......	Curb
Population, less than 100,000.											
Atlantic City, N. J	Contract	City	......	......	......	......	......	......	......	......	......
Allentown, Pa	City	City	No	No	No	......	......	Yes	......	......	Both
Berkeley, Cal	Contract	Tenant	No	No	Yes	......	......	Yes	......	......	Rear
Covington, Ky	City	City	Yes	No	Yes	1.00	.5 m.	No	......	$2.50	Curb

Charleston, S. C.	City	City	No	No	Yes	0.47 y.	1.25 m.	No	Steel	$1.50	...
Duluth, Wis.	Cy. & cont.	Tenant	No	No	Yes	...	...	Yes	Steel	...	Rear
Fort Wayne, Ind.	City	City	Yes	Yes	No	...	...	Yes	2-t. iron	...	Rear
Holyoke, Mass.	City	City	Yes	No	...	...	...	...	...	...	...
Kansas City, Kans.	Private	Tenant	...	...	...	...	...	...	...	...	Rear
Lynn, Mass.	City	City	Yes	No	Yes	0.35 y.	1 m.	No	4-y.	$2.50	Rear
Mobile, Ala.	City	City	...	...	Yes	...	...	...	...	$2.00	...
Norfolk, Va.	City	City	Yes	No	Yes	0.69	1 m.	No	1½-y.	$2.05	Curb
New Britain, Conn.	City	City	No	No	...	...	...	...	...	...	...
Peoria, Ill.	City	City	Yes	No	Yes	0.75	1 m.	Yes	...	$2.00	Rear
New Bedford, Mass.	Contract	Contract	Yes	No	Yes	...	...	...	...	...	Rear
Sacramento, Calif.	Contract	Tenant	No	No	No	...	...	No	...	$3.00	Rear
Savannah, Ga.	Contract	City	Yes	No	No	...	...	Yes	2-y.	$1.75	Rear
Somerville, Mass.	City	City	Yes	No	Yes	0.50 y.	1 m.	No	...	$2.25	Curb
Schenectady, N. Y.	Contract	City	Yes	No	Yes	...	...	Yes	...	$2.50	Rear
Springfield, Mass.	City	City	Yes	No	Yes	3.50	3 m.	No	3-y.	$2.25	Rear
Sioux City, Ia.	City	City	Yes	Yes	Yes	...	...	Yes	...	...	...
Syracuse, N. Y.	City	City	Yes	...	...	...	...	...	5-t.	$1.70	Rear
Terre Haute, Ind.	City	City	No	No	No	0.60	1.5 m.	No	...	$2.00	Rear
Tacoma, Wash.	Contract	Tenant	...	...	...	...	...	...	...	...	...
Utica, N. Y.	Contract	City	Yes	No	Yes	...	...	No	2 and 3-y.	$2.00	Rear
Passaic, N. J.	City	City	No	No	Yes	0.62	1 m.	No	...	$2.00	Curb
Lawrence, Mass.	City	City	...	...	...	0.75 t.	2 m.	Yes	...	$2.25	Rear
Spokane, Wash.	City	Tenant	Yes	Suggest it	Yes	0.65 y.	1 m.	Yes	3½ y.	$3.75	Rear

*—Team and driver. y—cu. yd. t—ton. Cy—city. Cont—contract. Gen.—general.

TABLE II—DISPOSAL PLANT DATA

Name of city.	Method of disposal.	Revenue.	Ownership.	Total Investment.	Capacity, tons.	Disposal of residue.	Valuable clinker.	Local nuisance.	Plant built.	Cost of disposal.	Cost includes.
Population Over 1,000,000.											
New York	Reduction	...	Priv.	...	...	...	...	Yes	...	...	...
Philadelphia	Reduction	...	Private at present, but studying for municipal ownership.								
Chicago	Reduction	D. g.	Mun.	$725,000	800	Sold by contract	No	Yes	1914	...	...
Population 500,000 to 1,000,000.											
Baltimore	Reduction	...	Priv.	...	...	...	...	...	...	...	...
Boston	Reduction	...	Priv.	...	...	...	...	...	...	...	...
Cleveland	Reduction	Yes	City	300,000	...	Gr. fert.	No	No	1905	$2.16	Everything
Pittsburgh	Reduction	...	Priv.	...	...	...	...	Yes	...	...	...
St. Louis	Reduction	No	Priv.	300,000	400	Gr. tank.	No	Some	1913	.878	...
Detroit	Reduction	...	Mun.	...	100	...	...	...	...	...	...
Brooklyn	Reduction	...	Priv.	...	...	...	...	...	...	...	...
Population 300,000 to 500,000.											
Buffalo	Reduction	...	Priv.	...	...	...	...	...	...	...	...
Cincinnati	Reduction	...	Priv.	...	...	...	...	...	...	...	...
Los Angeles	Reduction	$0.51 per t.	Priv.	...	300	Gr. fert.	No	No	1914	...	...
Milwaukee	Incineration	No	Mun.	210,000*	300	Dump	No	No	1910	1.23	Labor and supply
Minneapolis	Incineration	For heat	Mun.	110,000	150	...	No	No	1898	.48 net	Everything
San Francisco	Reduction	...	Priv.	...	...	...	...	...	...	...	...
Seattle	Sanitary fill	...	Mun.	...	...	...	...	...	...	...	...
Washington, D. C.	Reduction	Yes	Priv.	...	...	Gr. tank.	No	No	1900	...	...
Population 100,000 to 300,000.											
Albany	Feed to pigs	...	...	...	...	...	...	...	...	...	...
Bridgeport	Reduction	No	Priv.	...	60	...	...	Yes	1910	...	...
Cambridge	Feed to pigs	Yes	...	...	...	...	...	...	...	...	...
Columbus	Reduction	...	Mun.	...	...	...	...	...	...	...	...
Dayton	Reduction	Yes	Mun.	55,000	40	Gr. tank.	No	No	1915	...	...
Denver	Feed to pigs	...	...	...	...	...	...	...	...	...	...
Grand Rapids	Feed to pigs	Yes	...	...	...	...	...	...	...	...	...
Hartford	Feed to pigs	...	...	...	...	...	...	...	...	...	...
Indianapolis	Reduction	No	Priv.	...	...	...	...	...	...	...	...
Oakland, Cal	Dump at sea	No	...	...	140	Dump at sea	...	...	...	.60	...
Portland, Ore	Incineration	No	City	100,000	150	Dump	No	No	1911	.34	Labor, repairs, maintenance.
Providence	Feed to pigs	No	...	...	...	...	...	...	...	...	...
Reading, Pa	Incineration	No	Mun.	25,000	100	Dump	No	No	1914	1.00	Fuel and wages
Rochester	Reduction	No	Priv.	...	240	Gr. tank.	No	Some	1905	...	...
Trenton	Incineration	No	City	36,000	65	Dump	No	No	1901	.48	Running expenses
Paterson	Incineration	No	Mun.	85,000	60–90	Dump	No	No	1913	1.12	Labor only

Population Less than 100,000.

Troy, N. Y.	Reduction		Priv.								
Akron, O.	Reduction		Mun.								
Atlantic City	Reduction		Priv.					Yes			
Allentown, Pa.	Incineration	No	Mun.	20,000	25	Dump	No	Some	1905		
Berkeley, Cal.	Dump at sea	Has incinerator but doesn't use it.				Dump		No			
Covington, Ky.	Incineration	No	Mun.	25,000	100		No	No	1897	1.75	Fuel and labor
Charleston, S. C.	Filling marshes										
Duluth	Incineration	Some	Mun.	35,000	25	None	No	No	1905		
Fort Wayne, Ind	Incineration	No	Mun.	15,000	40		No	No	1895	2.09	
Holyoke, Mass.	Feed to pigs	No									
Kansas City, Mo.	Feed to pigs										
Lynn, Mass.	Feed to pigs										
Mobile, Ala.	Filling	No	Priv.								
Norfolk, Va.	Incineration	No	Mun.	11,800	16–24	Dump	No	No	1915	.35	Labor only
New Britain, Conn.	Feed to pigs										
Peoria, Ill.	Bury									.93	
Sacramento, Cal.	Incineration	No	Mun.	60,000	100	Dump	No	No	1907	.50	Everything
Somerville, Mass.	Feed to pigs										
Schenectady, N. Y.	Reduction	$65	Mun.	110,000	20–25	Sold	No	Some	1914	4 40	Everything
Springfield, Mass.	Reduction	Indirectly	Priv.		75		No	Some	1913		
Sioux City, Ia.	Burying										
Syracuse, N. Y.	Reduction		Priv.					No			
Terre Haute, Ind.	Incineration	No	Mun.	15,000	50–75	Dump	No	No	1909	.75	Fuel and labor.
Tacoma, Wash.	Dump on tidal flats										
Utica, N. Y.	Reduction	No	Priv.		100	Fuel	Yes	No	1904		
Passaic, N. J.	Bury										
Lawrence, Mass.	Sell to contractor	$3,000									
Spokane, Wash.	Incineration	500	Mun.	90,000	120	Sell ash	No	No	1907	2.99	Everything
Meadville, Pa.	Incineration		Mun.								
Erie, Pa.	Incineration		Mun.								
York, Pa.	Reduction		Priv.								
New Bedford, Mass.	Reduction		Priv.		30		No	No	1905	25,500.00*	
Savannah, Ga.	Incinerator-destructor		Mun.		130	Roads	Yes	No	1914	.615 gross	Labor and fuel
Wilmington, Del.	Reduction		Priv.								

*Without land. †—Per year. D. g.—Dried garbage. Priv.—Private. Mun.—Municipal. Gr.—Grease. Fert.—Fertilizer. Tank.—Tankage.

bage vary from $1.10 to $3.48 per ton. In only eight of the seventy-one cities reporting, does the householder pay for collection. In the balance of the cities the cost of collection is paid for out of general taxation. Thirty-two cities have municipal collection.

Thirty-three cities require the garbage and rubbish to be separated.

Only five cities require it to be wrapped.

Twenty-five cities specify a standard size can.

Thirty-six cities collect garbage and ashes from the rear of houses.

Almost every type of wagon is in use, usually a steel body dump wagon carrying about three cubic yards.

Twenty-nine cities collect ashes and rubbish separately. The cost of collection reported varies from 35 cents per ton mile in Newark, N. J., to $1.16 in Springfield, Mass.

There has been a steady development for the past ten years toward more improved methods in the matter of garbage disposal. Reduction, the source of much that is objectionable in the way of disposal, can be rendered practically non-odorous, according to the report of Mr. Irwin Osborn, consulting engineer, who studied the situation at Barren Island, New York. Increased costs will necessarily be a result, but in the matter of public health and sanitation the item of expense should be a minor consideration.

In the method of incineration, which must of necessity be the method employed by the bulk of our cities, the tendency has been away from the old type of low temperature furnaces toward the high temperature furnaces, doing away with the objectionable odors emanating from the old low temperature type. The wrapping and draining of garbage, in connection with this method of disposal, is recommended both as a health measure in keeping the cans clean, and also in reducing the moisture in the garbage and consequently reducing the amount of heat required for incineration. There are several new types of high temperature furnaces now being operated, one being a water-jacketed type, and the other a modification of the Dutch oven with a movable platform which runs into the furnace. Satisfactory results are reported from both these types, both of which have been described in detail in recent numbers of the Municipal Journal. The utilization of heat for furnishing steam

is being successfully tried by a number of cities. The problem of deriving a revenue from waste products in connection with incinerators, seems of rather doubtful value since most wastes cost almost wholly as much to recover as their market value would be. For instance, Buffalo, at its refuse utilization plant, spends $35,156.00 to recover waste worth $36,425.00. A separation of rubbish and garbage by the householder with a separate collection seems the more desirable method.

Collection methods are still very far from being perfect, with almost every conceivable type of wagon being used. Little or nothing in the way of valuable data seem to be obtainable, and yet in most instances cost of collection is the largest item in connection with garbage disposal. Central collection plants are being urged in some cities, but unless, as Mr. Folwell urges in a recent editorial, wagons and carts are so designed as not to be suspected of carrying garbage, the matter of a central station while it would materially aid in reducing hauling costs, would not tend to reduce the amount of objectionable odors, resulting from poorly .designed carts. Syracuse, N. Y., has installed a three-ton truck collection system which will carry fifty-four cans of one hundred pounds each. These cans are washed each day at the reduction plant. Two cans are required by this method, but the increased cost will no doubt be offset by the decrease in objectionable odors.

Valuable clinker, available for concrete and road building, is now being produced at some of the high temperature incinerators.

In view of the facts reported in this investigation, municipal collection of garbage and rubbish seems most desirable, but should have careful management and close supervision by competent inspectors.

Discussion of this paper will be found on page 27.

THE OPERATION AND EFFICIENCY OF THE HIGH TEMPERATURE DESTRUCTOR PLANT AT SAVANNAH, GEORGIA.

By E. R. Conant, Chief Engineer.

During the past year many of you have read of the difficulties experienced in some cities in reaching a satisfactory settlement with the contractors who have installed High Temperature Destructor Plants. On account of considerable publicity regarding this matter undoubtedly many city officials are skeptical as to the success of the modern high temperature destructor plants, and it is my pleasure to report to you with considerable detail, the efficiency and cost of operation of the high temperature destructor which has been in operation in Savannah for a period of time sufficient to form a very good opinion as to its efficiency, and also of the true cost of destroying refuse of the character found in southern cities.

By my investigation, and from information received, it is my opinion that in many instances the failure to operate destructor plants in a satisfactory manner has been due to a lack of proper study of local conditions and to the employment of incompetent supervisors to operate the plant.

The high temperature destructor plant at Savannah is of the Heenan-Froude type and was constructed by the Destructor Company of New York City. It was completed in March, 1914, and after necessary test was made of the plant, and after it had been operated for five months by the Destructor Company to make sure that all guarantees could be carried out, the plant was accepted and final payment was made on September 2nd, 1914.

The proceedings of the A. S. M. I. Convention of last year; also the September issue of the American Journal of Public Health, give a detail description of the plant and other data concerning same. The plant has a rated daily capacity of destroying 130 tons of mixed refuse, which consists of household, hotel and restaurant garbage and rubbish collected from household and stores, and ashes from households and other buildings, excepting manufacturing plants. Street sweepings and carcasses of dead animals are sold for revenue and are not delivered to the plant.

There are two furnaces of 65 tons capacity each, and each furnace has four cells. Each unit has a combustion chamber, a 200-horse power water boiler, pre-heater or regenerator and centrifugal fan for supplying force draft. The cells are fitted with trough

Dumping refuse from wagon into storage hopper.

grates. The receiver is of 260 cubic yards capacity, and the refuse is carried to the containers over the furnaces by an electric hoist and Heyward Bucket. All steam is super-heated and that not required to operate the plant is conveyed direct by steam line to the main steam header of the boilers in the water works pumping station located only a short distance from the Destructor Plant. Clinker from the plant is carried out on specially constructed clinker cars to an unloading platform approximately 75 feet from the furnace doors; here it is dumped on an inclined platform. In front of the inclined platform there is a runway at the proper elevation so that carts can back up under the platform and the clinker is rapidly scraped into same. This method of carrying away the

clinker is the most economical possible. The clinker in weight averages 25% of the total weight of refuse destroyed. The total cost of the plant including outlays other than that paid the contractor was $127,000. It was built upon city property so that the purchase of land was not necessary, and the amount stated does not include any credit for the land occupied.

The principal guarantee made by the Destructor Company was that it would destroy 130 tons of refuse in twenty-four hours, based upon a type of refuse which would have 45% garbage, 40% rubbish, 5% manure and 10% ash. It was further guaranteed that no odors or obnoxious gases shall escape from the chimney or stacks; that at no time during the operation of the plant shall the temperature fall below 1250 degrees F., and that an average temperature of 1500 degrees shall be maintained; that the number of pounds of steam generated in the boiler from and at 212 degrees per pound of refuse consumed shall not be less than 1.3 pounds; that the net effective capacity in horse power for steam utilization over and above that required for operating the plant shall be 300 horse power, based on 34½ pounds per boiler horse power. Further, that the cost per ton for incineration, based upon a certain schedule of wages and with a certain force, as follows, shall not exceed 40.4 cents per ton.

Cranesman, one man per shift of eight hours, $2.40.

Stokers, four per shift of eight hours at $2.40.

Clinker removing, one man per shift of eight hours at $1.50.

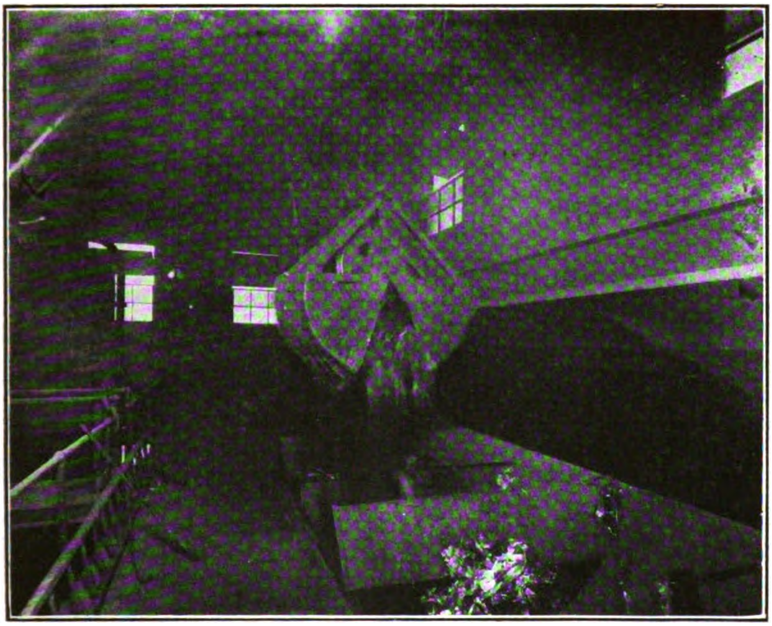
Engineer, one man per shift of eight hours, $4.00.

Total labor charges per shift of eight hours, $17.50.

Total labor charges per day, $52.50.

Another guarantee is that the amount of refuse consumed shall not be less than 68 tons per square foot of grate area. I can report that all the guarantees have been met. While we do not have 130 tons of refuse to consume, we have for a considerable portion of the past year consumed the refuse collected with one furnace, showing that the capacity of the two units is in excess of the guarantee. Official tests also showed that the capacity exceeded the amount stipulated. No odors or obnoxious gases escaped from this chimney or building. The temperature in the combustion chamber exceeds the guarantee, and in fact at times it rises above a safe limit, and we have installed a sprinkling apparatus so that when necessary,

the refuse can be sprinkled before it is taken to the furnaces. Sufficient tests have been made, and the practical working of the plant shows that the amount of steam generated exceeds the requirements. The operating cost per ton of refuse incinerated, based on the full



Grab-buckets dumping refuse into containers above the furnace cells.

capacity of the plant, has been met during tests, but during practical operation we do not have anywhere near 130 tons of refuse, and the operating cost for destroying the amount delivered to the plant is necessarily greater per ton than 40.4 cents. However, this unit of cost would be met if the plant was worked to its full capacity.

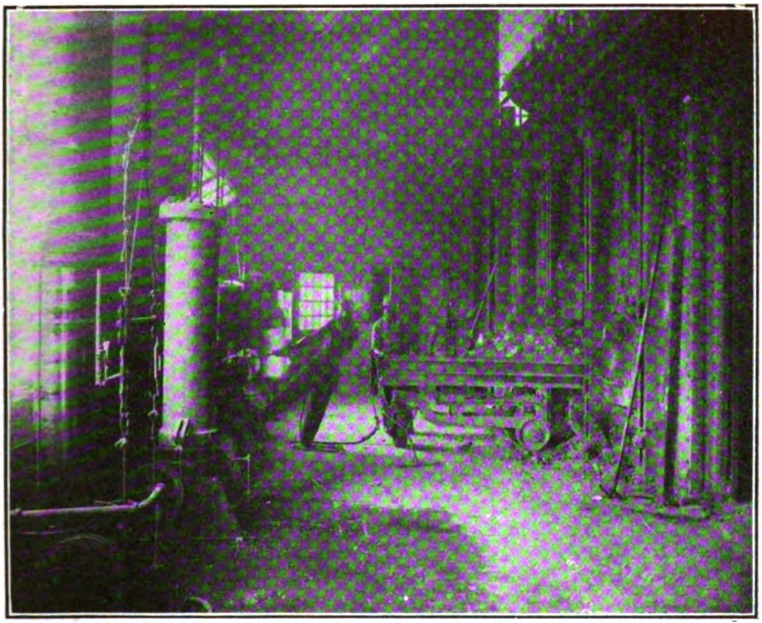
The condition of the plant at this time after operating for a year and a half is excellent. The same linings that were originally installed in the furnaces are still being used, and will probably be good for another six months. Very little work has been required in repairs to the brick linings of the combustion or furnace chambers. At the base of the combustion chamber a little damage was

done to the walls in removing the ash, which vitrified and which had to be picked away when removed. This trouble was readily obviated by keeping a layer of dust from the chimney against the floor wall. The principal cost of maintenance has been in keeping the armatures of the motors in good condition. No doubt much of the trouble is due to dust. Certain repairs also had to be made to the electric conveyor or hoist. Much of the expense of maintaining the plant the past year, the amount of which will be given below, is paid for by the Destructor Company under their guarantee, so that the actual cost to the city for the maintenance of the plant for the last year will be considerably less than that stated in the tabulation.

One feature of the plant could be improved upon, that is, the method of conveying the refuse to the furnace containers, is as stated above, by electric crane with Heyward Bucket. This is more expensive than it should be, but up to this time a more economical arrangement has not been put in use, altho steps are being taken to reduce the operating cost of conveying the refuse. Other than this feature, I do not know where any general improvement could be made to our plant. I may say that it is very successful. In the year and a half that it has been operated it has never been shut down but once or twice, and then for only a period of less than a day.

The refuse delivered to the plant consists of 40 to 45% garbage, approximately 50% rubbish and 5 to 10% ashes. In the rubbish there is a great amount of tin cans and other indestructible matter. During our watermelon season in July and August, the amount of garbage is increased between 15 and 20% per day, due to the collection of watermelon rinds. This years it averaged 15 tons per day and last year about 20 tons per day. During these two months when there is an excess of garbage we add to the refuse hopper about 10% additional weight of ashes and cinders. The cinder is collected in a pile during the season when it is not necessary for consuming the garbage, and the only labor cost involved is the wheeling of the cinder from the storage pile to the hopper during the period when the excessive collection of garbage takes place. No other fuel whatsoever is used for destroying our refuse. The clinker from the plant varies from 20 to 30%, according to the cinder and about half the clinker in weight is more or less vitrified. At first it was believed that this clinker would have no value, but after a trial in

using this material for a foundation for hardening streets it was found that it is eminently adapted for this purpose, and streets that have been hardened with the clinker, and have been in use for over a year stand up under heavy traffic, and is found to be more durable



Clinker drawn by mechanical means into clinker car for removal from furnace.

than with the use of gravel. Considerable of the clinker is sold to property owners, who pay a nominal price for same, and in one instance seventy-five cars have been filled and hauled by railroad twenty-five miles to be used as a foundation upon beach sand over which gravel was placed, and this roadway, some two miles long, has stood up very well. The tin and sheet iron oxidizes and compacts with the ash and carbon, making a very solid foundation stratum.

All steam from the plant in excess of that used for operating the plant, is conveyed to the pumping station, and by so doing has reduced the cost of fuel at the station considerably, as will be shown in the tabulation given below.

The amount of refuse consumed and the cost of operation has been compiled for one year dating from October 1st, 1914, to September 30, 1915, inclusive.

During this period 27,495 tons of refuse was destroyed, equivalent to 75.33 tons per day. The month when the burning was heaviest was July, when the average amount destroyed was 105 tons. The lowest month was February, when the daily average was 66 tons per day. The amount of clinker and ash obtained was approximately 8,950 pounds.

Cost of Operation.

The total cost of operation for 12 months was	$15,300.00
or per month of	1,275.00
or per day of	42.50

The above is based upon the following scedule:

1 Engineer, per shift of eight hours	$ 4.00
1 Cranesman, per shift of eight hours	2.25
1 Laborer, per shift of eight hours	1.50
3 Stokers, each per shift of eight hours	1.75
This is equivalent to	13.25
for each shift of eight hours or	39.75
per day of 24 hours.	

To this is added appropriate charge for Superintendent's services, who also acts as Superintendent of Garbage Collection. During the months of July and August an extra stoker has to be employed at times, so that the average operating cost per day for the year is, as stated above, $42.50. All of the refuse collected is weighed, and the weighman is paid $2.50 per day, which amounts to $972.50 for the year.

A laborer is required in the tipping room, where the refuse is delivered to the hopper from the carts. This could be charged to either the collection of garbage or the destroying of garbage. As stated above, during July and August some extra labor is required in transferring cinders from the storage supply to the hopper.

The total amount paid for this labor during the year was	$ 695.00
The cost of removing clinker from clinker platform to final place of deposit for the year was for labor	1836.60
Cost of teams employed	579.00

Making total cost of	**$2415.60**
The credit for steam furnished the pumping station for the year	**5446.00**
For clinker sold	**217.84**
Credit given for clinker used in hardening streets and road surfaces was	**656.60**
Making a total credit for the clinker	**899 44**
Total maintenance cost for the year amounted to	**1213.11**

Steam pipe connection between destructor plant and water works plant. Teams entering the unloading platform. The pile of cinders in the foreground collected during the winter, aids the combustion during July and August of watermelon rinds and excess vegetable matter, amounting to 15 or 20 tons a day for those months.

however, the city is to be reimbursed for a considerable portion of repair cost by the Destructor Company. Under the guarantee of the Destructor Company the maintenance of the plant for a period of five years shall not exceed 1% of the contract price, which was $120,000.00, making the maintenance allowance $1200.00.

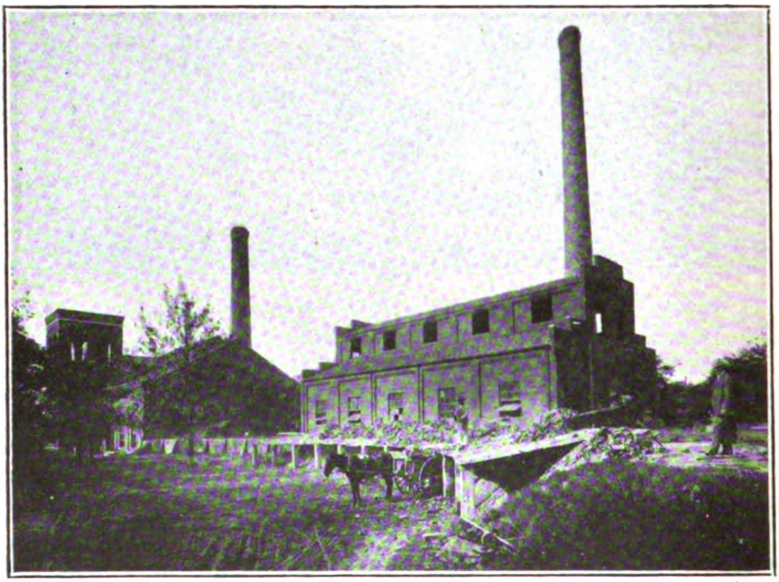
As stated above, the principal item of expense during the year was upon the electric motors and the inspection and upkeep of the electric apparatus, which cost $559.36. This amount is considered excessive, and it is anticipated that this amount will be very much

less in the future. The cost of general repairs amounted to $274.46, and for the purchase of tools, fixtures, records and other minor items $219.81.

For oils and waste, $159.48.

The expenditures for outlays during the year was approximately $1167.00, which expenditures were for constructing clinker platform, retaining wall, rebuilding clinker carts, laying drainage pipe, etc.

Recapitulation of the operating cost for twelve months and cost of destroying refuse, including interest on investment and depreciation of plant.



At right, man is unloading clinker car on to clinker platform by operating an endless chain which slides clinker from car to platform. Carts carry clinker to road or fill. Windows removed from plant to give better ventilation in summer. No objectionable odors or dust emanate from the open building. Water works plant at left.

Refuse destroyed				26,795 tons
Total cost of operating plant	$15,300.00			
or per ton		55.65 c		
Total maintenance cost	1,213.11			
or per ton		04.52 c		
Total operating cost	16,513.11			
or per ton		60.17 c		
Credit for steam furnished pumping station			$5,446.00	
or per ton				20.33 c
Total net operating cost	11,067.11			
or per ton		39.84 c		
Cost of labor in tipping room	695.00			
or per ton		02.16 c		
Cost of weighing	972.50			
or per ton		03.25 c		
Total net cost, including above	12,734.61			
or per ton		45.24 c		
Cost of clinker removal	2,415.60			
or per ton		08.79 c		
Credit for clinker			899.44	
or per ton				03.36 c
Net cost of removing clinker	1,516.16			
or per ton		05.43 c		
Total cost, including clinker removal	14,250.77			
or per ton		50.67 c		
Interest on investment, assumed to be $127,000.00 at 4% amounts to	9,080.00			
or per ton destroyed		18.47 c		
Total cost, including above	23,330.77			
or per ton		69.14 c		
Depreciation of plant, giving due weight to all of the various portions of the plant, it is assumed that the annual depreciation will amount to	6,100			
or per ton destroyed		22.18 c		
Total cost of destroying refuse for twelve months including all of the above amounts to	29,430.77			
or per ton		91.32 c		

In order to make a comparison of the cost of destroying refuse in various cities, it is necessary to have not only the maintenance cost, and labor operating cost, but also the interest on investment should be considered as well as depreciation of the plant. With the

One of the roadways surfaced with clinker from the garbage destructor plant, which has been used for heavy traffic for about six months. Since the photograph was taken the edges have been rolled and the roadway has been crowned.

plant working at full capacity the cost per ton would be very much less than that noted above and the total cost would be less. As the interest on the investment and the depreciation would remain the same and the only additional force to operate the plant would be one or two laborers, and very slight additional force would be required to remove the clinker. All of this extra cost would be more than made up by the additional steam that would be furnished by the burning of the additional refuse. There is apt to be too much stress laid upon the actual labor cost in destroying the refuse. It will be seen from the above tabulation that the labor cost is only 43% of the total cost, so that upon making investigation before installing a plant of this character the facilities by which the clinker can be handled, the use to which the by-products steam can be put is equally as important as the actual labor cost for operation.

The operation of the plant at Savannah will be watched closely. It has met with the approval of the officials of the city and people of Savannah. The refuse is being destroyed in a sanitary manner. The building is located close to one of our pumping stations and no objectionable feature has arisen of any character since the plant commenced operation.

DISCUSSION.

Of Three Preceding Papers on Garbage Collection and Disposal.

Mr. Tribus: I think it would be rather interesting to learn if any of those here know of any other instance in the country among garbage disposal plants where the refuse has been placed in automatic carriers for charging into the furnaces. There is a plant in New York City where the garbage is dumped upon a platform, and there loaded by hand into a carrier which is pushed by hydraulic power into the furnace, and the bottom withdrawn, leaving the charge evenly spread over the grate without any further handling: following which, the rest of the carrier is pulled out. About 20 seconds elapses from the opening of the door in. the furnace to receive the charge to its final closing. In most of the processes it takes much longer than that; in fact, in practically all of them. In this instance it has been quite successful, and the total operation is holding down to somewhere around 40 cents a ton for the plant costs of disposal.

Mr. Folwell: I would like to ask Mr. Tribus just what was the arrangement of the Paterson plant.

Mr. Tribus: The Paterson plant has a top feed, into which the garbage is dumped from a grab bucket, operated from a traveling crane. Hydraulic power is used to open the convers of the furnaces, and then the charge is dropped down in a mass. The cover is not open for any great length of time, but the men have to spread the charge with hand rakes.

Mr. Folwell: On the general matter of garbage disposal we had three papers, and perhaps it would be desirable to discuss all three together rather than one at a time. In that connection, I simply

wanted to arise to call attention to the excellence of the report sent in by Mr. Conant as to the detail in which he gives the cost data in connection with that furnace. Until more of the managers of our furnaces will take the pains which Mr. Conant has set out in his paper, we will not make as much progress in this matter as we should. The trouble is now that so many are inventing and building furnaces and so few men are operating them in an intelligent way, or at least giving us intelligent information as to how they are being operated; and in a great many cases the success of the furnace is going to lie in the operating value as much as in the construction. I simply want to commend the detailed information on this subject which Mr. Conant has given us, and hope that other cities will adopt something of a similar detail in reporting operating expenses and general details.

MR. HERING: I would like to state that it has been hardly 20 years since this whole question of garbage and city refuse, on which we have had several excellent papers, has been taken up for scientific investigation by the engineering profession. Twenty years ago, and even here and there to this day, this matter was in the hands of the medical profession. At that time I did not know one engineer in the United States connected with any system for the collection and disposal of garbage. I then participated in a discussion of this subject at a meeting of the American Public Health Association. It may have been the first time that an engineer had arisen to contradict the medical profession in this matter. The consequence was, as very often happens when a man criticises a committee's work, I was put on that committee. So I had to make good. I started, in the way an engineer does, to collect data, so that we could know what we were talking about. A very large collection was made, and a very careful study was made of this whole question, both in Europe and our country, and finally certain conclusions were reached which I believe hold good today. This question is one entirely for engineers. The medical profession had at one time a very proper interest in preventing nuisances. Now, the engineer can do this better, because he knows how those nuisances are caused and how they can be prevented.

We have made a great deal of progress, I am glad to say. In England, where they have been bothered with this subject more than in any other country, they made the greatest progress. There

it has been in the hands of the engineers right along, and we find the best furnaces and best methods. We have always looked there for information and we have been trying to apply that information here as far as we have been able to, and in the last few years we have had some excellent examples.

I would like to add that we have in this country a peculiar situation in reference to garbage. It is the only country in the world where the city waste is sufficient—because that is what makes it possible—to have what we call the reduction system. In England, in France or in Germany, you could not get enough grease out of the garbage to think of putting up a reduction plant. They tried it in one of the suburbs of Berlin and fell down. The Europeans are far more economical than we are; they save everything, as far as possible, and so there is no grease left to make its extraction profitable. Here it is different, and I have always said a good word for reduction, because here it furnishes a practical solution. But we can at once see that for small cities it would be impracticable, because the expense is too great. Therefore, reduction is confined to the larger cities, and for these, I think, it is always a question which ought to be investigated. There are some large cities where I believe the wrong system is used today, and where I believe a thoro investigation, on a modern engineering basis, would throw the selection the other way. There are some other difficulties to be met. I know of two cases where the engineer's report indicated one process as being utlimately the most economical, but the immediate social and political conditions threw the selection the other way. I think this was right because for the immediate purpose it was better to do so. The whole question of garbage is one of some intricacy, and it should be given more study and consideration than formerly.

There is just one thing more to say with reference to incineration. In our country we have been very unfortunate in not being able to utilize the products of incineration as we should do and as, I am quite sure, we shall be able to do in the future. In England, there are two products from high temperature incinerators; one is the steam, and the other is the clinkers and ashes, both being products of combustion. In England, they are obliged to be more economical than here. They have utilized the clinker, estimating its value at about a shilling or 25 cents a cubic yard, which is a sure income. In our country we have tried to use the clinker here and

there, but seldom was this done wtih profit. The steam has also been utilized in England far more than here. It is hardly ever allowed to go to waste in Europe. But in our country there are many incinerators where all the valuable steam goes up the chimney. The difficulty is right here: The incineration of refuse is not a constant process. Sometimes there is far more heat than at other times, not only because the delivery of refuse is irregular, but the season controls. For instance, in the Fall, as you heard mentioned in one of the papers, we have an excess of water melon rinds; containing a lot of moisture and therefore not readily combustible. You cannot possibly get the heat out of such garbage that you can get at some other season. Nor can you get much heat without a fair amount of unburned coal, delivered in the ashes. On the continent of Europe, the estimate is about 5% of the ashes as unburned coal; sometimes less than that. At the seacoast and in England, this figure is up to 25%. In our country we find the latter to be a fairly good figure for us. Sometimes it is even greater for domestic coal. Steam ashes have less unburned coal. In oil and natural gas districts, very little coal can be relied upon. This irregularity bars a satisfactory sale of steam to manufacturers.

The question then, is what can we best do with that steam in our country? In Milwaukee they have a fortunate condition. They use it for pumping lake water to flush out one of the rivers. They can pump when they have the power, and do not pump when they have not the power. That is one good application, but it is rare. There is another use, which I believe will be profitable in this country, when you can convert the steam into electricity to load up storage batteries. That means when you have a lot of steam you load up more storage batteries than if you have none. These storage batteries in some cities of Europe are put on the refuse collection wagons. The ctiy of Hamburg, for instance, collects most of its refuse by motor trucks, driven by the storage batteries which they find ready for them at the station.

MR. MILLER: In regard to what Mr. Hering has said as to reduction plants and incinerators, and taking them out of the department of the medical profession, even tho the engineers are building the incinerators and reduction plants at the present time, it is unfortunate that the control seems to have passed out of their hands. In sending out these inquiries referred to in the report which I made,

all of them were sent to the department of public works, and a large number of the replies came from the health departments, showing that the matter of control has largely passed out of the engineering departments of the cities. As a result, the cost data which were supplied were very unreliable and inaccurate.

MR. TRIBUS: It seems to me that the failures, and there have been many failures, of refuse disposal plants of different classes in this country, as economical problems, come from two causes: First, a plant is adopted in some place because a committee from that place has seen two or three other plants in the vicinity, and they have been told "that is what you want." Then they may call on some engineer to tell of the merits of those examined—usually they do not —but if thev do, he says, "Yes, they are very good plants and seem to work well." They proceed to issue bonds and build a plant from manufacturer's design. Then comes its failure, because it is not fool-proof. The best plant that can be built today to cover every phase of nuisance, will fall down unless it is properly managed. I have one in mind where everything was done practically that could be done, and there is a great chamber at the foot of the stack where the dust is supposed to settle as the gases are supposed to pass thru slowly. They do until the operators allow the chamber to choke up with dust, and then it goes up the chimney with the gases. And people say then, the destructor is a failure and it is, but from lack of proper handling.

There is another factor to be considered in every scheme, but one not often considered. It is not simply whether a reduction system, a crematory or an incinerator is desirable, but it is, can we educate the public so that it will consider the total costs of collection (length of haul a factor, and the proper removal from collecting stations) as well as the final treatment process, and then the disposition of the by-products. Many of our cities are debarred from a free market for by-products; they can't sell the electricity; they can't sell the slag; they can't sell the grease and other things, in the open market. They have to be put up at auction, and we know what kind of prices are brought at auction. Some few cities are free from such restrictions. But until each individual place is considered on its own merits with the costs of haul, treatment, final disposition and so on, all estimated, we cannot settle the question, and we cannot advance in practice. And so many places are erring because of the hit or miss committee system.

REPORT OF COMMITTEE ON SEWERAGE AND SANITATION.

GEORGE H. NORTON, Chairman, Buffalo, N. Y.

Your Committee on Sewerage and Sanitation, subjects most intimately connected with the public health, accept the truth that, when brought directly to the individual, no price is too great to be paid for specific avoidance of or recovery from disease.

As engineers, however, we believe that with the great growth of improvements which are for the general betterment of the people, especially where congested in large numbers, the demands upon the public resources are so great and varied that the sound judgment of the engineer is demanded in order that the greatest results be accomplished within the available limit of resources.

We, therefore, set forth the following general conditions:

1. Public health is purchasable within certain limits;
2. Resources for the purchase of public health are not unlimited;
3. Sound engineering demands the greatest possible return for the dollar invested in health as for other purposes.

There need be no discussion of the first proposition.

The second needs but casual consideration to show its verity. The ultimate derivation of all such resources is from taxation and when the burden of such lies against a large number of citizens. each of limited means, all payments thru taxation deduct, not from a neutral margin of income over expense, but rather must decrease the available light, air, and space of the domicile, reduce the supply of nutritious and appetizing food, or deprive the feeble and the invalid of the extras so essential for improvement. A revenue raised for public health must, therefore, remain within limits or defeat its own object.

The third proposition needs no argument among engineers, but when it is proposed to introduce strict methods of analysis in the comparison between dollars spent and lives saved, the physician and the humanitarian are often inclined to offer objections. Such a fundamental line of reasoning as is natural to our profession is entirely foreign to their training and practice and is characterized by them as mercenary and unhumanitarian. It, therefore, appears increas-

ingly necessary that the engineer enter this field and assist in the creation of a public sentiment that shall, not merely further the splendid work that has already been done in the interests of public health, but rather will direct the lines of effort to the end that the greatest value may be received for the dollars expended.

For the purpose of this discussion, three classes of disease may bs here mentioned for which the number of deaths in the State of New York for the year 1914 were as follows:

> Tuberculosis 16,440; Communicable diseases—measles, whooping cough, scarlet fever, mumps and diphtheria, 4,242; and typhoid fever 867.

These deaths can all be characterized as preventable; that is, enough knowledge exists as to the causes of the disease and their method of transmission and infection that, given proper control and adequate funds, trained sanitarians, in course of time, could eliminate them all. To the sanitarian, however, but little, if any, distinction is made between deaths; between a death from tuberculosis and from typhoid fever. To the engineer, that life is best saved when saved at the least cost. Nor has the sanitarian in his eagerness to stamp out communicable disease always stopped to weigh carefully the value of the methods proposed. For example, in times past many dollars have been spent in burning sulphur in rooms where scarlet fever patients have been quarantined, a rather useless expenditure in the light of present knowledge. Or, bodies dead of smallpox, if transported, have been carried in lead-lined coffins, to the advantage, perhaps, of the undertakers but certainly to that of no one else. Or, again large sums have been spent on sewage purification works to improve, it was expected, the general health of the community, but just how and to what extent no one could say.

The prevention of communicable disease is not directly or materially within the province of the engineer and yet it may be useful to apply to the problem of public health some engineering principles of analysis before taking up the prevention of typhoid fever with which he is more directly concerned.

A well conducted hospital for incipient tuberculosis can give a nine months' treatment for from $500 to $600 and may reasonably expect at least fifty per cent recoveries. This establishes a cost of $1000 to $1200 for prevention of one death from this disease. The

ordinary value placed upon a human life of adult years is $5000 so that it apparently is economy to establish such hospitals, so long as they can continue with such results. But the prevention of tuberculosis is an even more economical proceeding, just as it is better engineering to build guard rails on a bridge than to plan expensive equipment for replacing trains on the tracks after they have been derailed. Public health teaching, dispensaries, district nursing, and sanitoria are the guard rails whose value needs to be emphasized by the engineer as an economic measure. Slowly public school medical inspection is growing in favor and the cost is so small and the value in preventing disease and epidemics is so great that, as engineers again, we should throw the weight of our approval in its favor.

In New York City, in 1909, 151 lives were saved by the use of $18,000 worth of diphtheria anti-toxin or $130 apiece. How much better engineering then in a community where diphtheria is prevalent for the city to postpone building sewage disposal works. Again, the cost of removing privies and wells from closely built up areas in a city is generally amply repaid by the reduction in typhoid fever and one case of the disease will cost as much as the elimination of a half dozen privies. Perhaps then, good engineering applied to public health will call for tearing down privies rather than walling in a creek that is at worst only an eye-sore.

In Providence, R. I., a few years ago, visiting nurses and infant consultations were provided for and the result of the first year's work was that 200 fewer babies died that year than ever before. It cost about $6000 or about $30 for each baby saved. In New Zealand the infant death rate is about 100, and there are 250,000 births each year. The broad question therefore to the sanitary engineer in New York State is: Is it not better to save babies lives at a rate of $30 each when there are 12,500 to be saved, than to spend thousands and thousands of dollars on elaborate sewage disposal plants, the real value of which in lives saved is quite problematical, and this notwithstanding the fact that the construction work of the engineer is diminished?

The presence of typhoid fever in a commuity is commonly taken as an index of the quality of water supply, a field and a problem particularly assigned to the engineer. We know that certain other intestinal diseases arise from contaminated or impure water supplies and while no definite statements are available it may be here

assumed that such other diseases cause as many deaths as typhoid. However, a material part of existing typhoid comes through fly transmission, from drinking unauthorized and known polluted waters, by contact, etc., so that a reasonable assumption may be made that the total typhoid deaths in a community, especially a city, may approximately represent the death loss through an imperfect water supply.

Having from tuberculosis established a reasonable assumption of results to be obtained from a given expenditure until tuberculosis treatment is well in hand, the problem is reduced to the form of, what can be done with either sewage or water which will prevent one death for $1000 or $1200 expended? and along what line shall the expenditure be made?

One city may be cited as an example, where the introduction of a water supply from a new source was followed by a reduction in typhoid mortality equivalent to a saving of one life at a cost of $1600 based on interest, sinking fund and operation costs.

This was followed by use of liquid chlorine treatment showing on a similar basis of computation a saving of life from typhoid for about $750. Both these are reasonable investments. Should filtration be considered as also desirable to further reduce the rate from 10 to 5 per 100,000 population, even at the low rate of $5.00 per million gallons, the expense per life saved would be upwards of $10,000 showing that filtration as an aid to public health would be an unwise expenditure of public funds until such time as other preventable diseases are under better control.

If any proposed improvement for water supply or sewage treatment for the benefit of the public health therefore involves an expenditure of large extent compared with the benefits to be derived and beyond those which may be expected from endeavors in other lines, then the duty of the engineer to the public is to set forth those conditions, fully as much so as to attain the most economic results in whatever construction work he may have in hand.

While there may be failure to appreciate the entry of the engineer into these broader fields and even a tendency to resent it in certain conservative circles, yet the responsibility which lies with the profession must be fairly met if the engineer be true to himself.

Within the usual field of sewerage and sanitation, the same methods of analysis have their more ready application. Exclusive

of physical nuisance and demands for decent appearance, sewage treatment may be necessary for the protection of public water supplies. Two points even here call for comment. The discharge of sewage into surface waters, unless in excessive amounts, increases the normal pollution temporarily but is soon lost by the several natural factors of dilution, sedimentation, etc. Many studies of streams, both in this country and in Europe, have shown this to be true in spite of occasional epidemics that seem to have been due to direct infection carried down stream for long distances. The normal pollution of surface waters is such that very rarely can such waters be used safely for drinking water without treatment. The cities on the Great Lakes, in spite of longer and longer intakes have found that a greater or less amount of impurities always remains in the water. The Finger Lakes of New York State, usually furnish water crystal-clear and nearly free from bacteria and yet, with certain winds, or with spring freshets, or with local pollution near the intake, occasional lapses occur and treatment of the water is necessary to insure continuous purity. Much more, then, do rivers like the Ohio and the Susquehanna need purification before the waters are used for drinking. The engineer then asks himself, why do Boards of Health, doctors and other sanitarians demand large expenditures for extensive sewage disposal plants when the effluents are to be discharged into streams already polluted? or, why must an effluent be made well nitrified when it will be so diluted by discharge that natural nitrification will surely follow? It is gratifying to know that, in the cases of Rochester and Albany, where the new sewage disposal plants are being built and planned, a decent regard for economy has eliminated all kinds of filters from the treatment, leaving only sedimentation to remove the coarser particles before the sewage is discharged into the large bodies of water adjacent.

The second point is that a comparison of two water supplies, one relatively pure and the other sewage polluted must be made on a financial basis rather than on one altogether sentimental. There is no longer a question of the possibilities of filtration and sterlization to purify a water, no matter how polluted. Yet engineers have been known to approve the development of large schemes for the bringing into a city of unfiltered water at great expense rather than to favor the education of the public in the value of treated water, largely it must be assumed, from their professional zeal for construction rather than from their calm judgment in engineering economics.

Attention is called to the valuable report of the sanitary engineers given before the International Joint Commission on the pollution of the Great Lakes Boundary Waters, a copy of which is filed herewith.

While not strictly within the lines of the work of your committee, attention is also directed to the advances made within recent years in the sterilization of potable water by chlorination and that the adoption of such as an independent or auxiliary treatment has made possible a safe water supply from sources moderately contaminated. This reduces to an extent the demand for expensive treatment of tributary sewage and exacts the co-ordinate study of both treatments for minimum costs.

The note-worthy recent advances in sewage treatment are noted as: Fine screening, which may well be applicable to the reduction of physical nuisance and even for sanitary protection in cases of large dilution, the construction of these screens following both the barrel type as developed at Reading, Pa., and at Baltimore, and the more recent Reinsch-Wurl screen, introduced from Germany; improvements in sludge digestion with sedimentation by deep and by separate digestion chambers; the reduction of sludge and its possible enrichment by aeration to such an extent as to make it commercially marketable.

Discussion of these improvements is not here possible, but at least these phases of improvement must be considered in the design or improvement of any treatment plant.

With the rapid strides being made in so many lines of sanitation there may well be feared too close a study of the details of construction and operation and interest in the results to be obtained without first having fully determined limits of the problem. When the engineer gives these great problems the broad analytical consideration so well within his ability and insists on their public consideration he will cease to be the artisan of prints and tripods and be recognized as the conservator of resources.

The aim of your committee has been to present to the members of this society the responsibilities resting with them to give, in their respective municipalities, that broad, cool and unbiased consideration to all plans for sanitation whereby it may be determined if the results will warrant the outlay, if greater results may be obtained along other lines of improvement and if the available resources warrant such improvement.

Having made such determination upon facts and logic, it is no less the duty of members of this society to present such facts and figures in the most conclusive manner to their municipalities that the public enthusiasm for sanitary betterment be directed along sound economic lines.

George H. Norton, Chairman,
R. C. Harris,
Henry N. Ogden,

INTERNATIONAL JOINT COMMISSION.

POLLUTION OF BOUNDARY WATERS.

FUNDAMENTAL PRINCIPLES UPON WHICH THE FOLLOWING CONSULTING SANITARY ENGINEERS WERE IN UNANIMOUS AGREEMENT.

The following statements represent the essence of the opinions given by us before your honorable commission at the conference held in New York on May 26th and 27th, 1914:

1. Speaking generally, water supplies taken from streams and lakes which receive the drainage of agricultural and grazing lands, rural communities, and unsewered towns are unsafe for use without purification, but are safe for use if purified.

2. Water supplies taken from streams and lakes into which the sewage of cities and towns is directly discharged are safe for use after purification, provided that the load upon the purifying mechanism is not too great and that a sufficient factor of safety is maintained, and, further, provided that the plant is properly operated.

3. As, in general, the boundary waters in their natural state are relatively clear and contain but little organic matter, the best index of pollution now available for the purpose of ascertaining whether a water purification plant is overloaded is the number of B. coli per 100 cubic centimeters of water expressed as an annual average and determined from a considerable number of confirmatory tests regularly made throughout the year.

4. While present information does not permit a definite limit of safe loading of a water-purification plant to be established, it is our judgment that this limit is exceeded if the annual average number of B. coli in the water delivered to the plant is higher than about 500 per 100 cubic centimeters, or if in 0.1 cubic centimeter samples of the water B. coli is found 50 per cent of the time. With

such a limit the number of B. coli would be less than the figure given during a part of the year and would be exceeded during some periods.

5. In waterways where some pollution is inevitable and where the ratio of the volume of water to the volume of sewage is so large that no local nuisance can result, it is our judgment that the method of sewage disposal by dilution represents a natural resource and that the utilization of this resource is justifiable for economic reasons, provided that an unreasonable burden or responsibility is not placed upon any water purification plant and that no menace to the public health is occasioned thereby.

6. While realizing that in certain cases the discharge of crude sewage into the boundary waters may be without danger, it is our judgment that effective sanitary administration requires the adoption of the general policy that no untreated sewage from cities or towns shall be discharge into the boundary waters.

7. The nature of the sewage treatment required should vary according to the local conditions, each community being permitted to take advantage of its situation with respect to local conditions and its remoteness from other communities, with the intent that the cost of sewage treatment may be kept reasonably low.

8. In general, the simplest allowable method of sewage treatment, such as would be suitable for small communities remote from other communities, should be the removal of the larger suspended solids by screening through a one-fourth inch mesh or by sedimentation.

9. In general, no more elaborate method of sewage treatment should be required than the removal of the suspended solids by fine screening or by sedimentation, or both, followed by chemical disinfection or sterilization of the clarified sewage. Except in the case of some of the smaller streams on the boundary, it is our judgment that such oxidizing processes as intermittent sand filtration, and treatment by sprinkling filters, contact beds, and the like, are unnecessary, inasmuch as ample dilution in the lakes and large streams will provide sufficient oxygen for the ultimate destruction of the organic matter.

10. Disinfection or sterilization of the sewage of a community should be required wherever there is danger of the boundary waters

being so polluted that the load on any water-purification plant becomes greater than the limit above mentioned.

11. It is our opinion that, in general, protection of public water supplies is more economically secured by water purification at the intake than by sewage purification at the sewer outlet, but that under some conditions both water purification and sewage treatment may be necessary.

12. The bacteriological tests which have been made in large numbers under the direction of the International Joint Commission indicate that in most places the pollution of the boundary waters is such as to be a general menace to the public health should the water be used without purification as sources of public water supply or should they be used for drinking purposes by persons traveling in boats.

13. It is our judgment that the drinking water used on vessels traversing boundary waters should not be taken indiscriminately from the waters traversed, unless subjected to adequate purification, but should be obtained preferably from safe sources of supply at the terminals.

14. While recognizing that the direct discharge of fecal matter from boats into the boundary waters may often be without danger, yet in the interest of effective sanitary administration it is our judgment that the indiscriminate discharge of unsterilized fecal matter from vessels into the boundary waters should not be permitted.

Yours respectfully,

George W. Fuller,
Earle B. Phelps,
George C. Whipple,
W. S. Lea,
T. J. Lafreniere.

THE PIONEER PLANT FOR TREATING SEWAGE BY THE ACTIVATED SLUDGE PROCESS.

By T. CHALKLEY HATTON, M. AM. SOC. C. E.
Chief Engineer, Milwaukee Sewerage Commission.

History has not established many instances wherein the United States has had the distinction of constructing the first plant for the complete treatment of sewage by means of a new process. It is true that new processes have been tried out in laboratories and testing stations for the first time in the United States, but, if they have proven valuable, our neighbors across the water usually get there first with an actual working plant.

Had it not been for the European war I have no doubt England would have built the first working plant for the treatment of sewage by means of the activated sludge process, as plans have been prepared and presented to the councils of the City of Salford for such a plant, but appropriations therefore have not been forthcoming, due, it is said, from hesitation of the city Fathers to spend any public funds other than those absolutely necessary, until the present unpleasantness is over.

It is, therefore, to the honor of the City of Milwaukee, if it shall subsequently prove that any honor be due, for building the first working plant to be operated by this process. It is true that the plant now being constructed is for the purpose of trying out this process upon a normal size unit, and is, to that extent, in advance of the work being done by the several experimental stations scattered throughout the United States in testing this process, but the building of this plant does not mean that the City of Milwaukee has adopted this process for the ultimate treatment of all of its sewage. This point will not be determined until after the plant now under construction shall have been operated throughout the coming winter months. It might be stated, however, that the Sewerage Commission of the City of Milwaukee feels pretty well assured that the process will prove satisfactory otherwise it would not feel warranted in expending $65,000.00 for installing the plant now under way.

For the purpose of acquainting the convention with the reasons for the Sewerage Commission feeling warranted in expending this

large sum of money in trying out a new process the writer desires to briefly present what has been done at the Milwaukee sewage testing station towards determining the most suitable method of treating the sewage of that city.

In 1913 a Sewerage Commission for the City of Milwaukee was created under the laws of the State of Wisconsin to design and construct works for the collection and disposal of the sewage from the city, and money was provided for the purpose.

In 1910 a board of engineers consisting of Harrison P. Eddy, George C. Whipple and John W. Alvord furnished a very excellent and complete report upon this subject, except that the method of finally disposing of the sewage was left somewhat problematical. Plain sedimentation, chemical precipitation and sprinkling filters were suggested. Deep Imhoff tanks were alluded to, but no definite recommendation therefor was made as such tanks were, at the time, being tried out.

Upon organizing, the Sewerage Commission decided to build and operate a testing station for the purpose of trying out the several processes recommended by the board of engineers, and any other which might give promise.

To this end the station was built and put in operation in September of 1914, and embraced fine and coarse screening, Imhoff tank and sprinkling filters followed by sterilization by means of liquid chlorine and electrolysis, slate tanks with aeration followed by sprinkling filters, and sterilization and chemical precipitation followed by sprinkling filters. Results from these several processes have been obtained, and all have been abandoned except Imhoff tank, sprinkling filters and chlorine sterilization, as not being applicable for treatment of Milwaukee sewage.

Late in the summer of 1914 the writer's notice was called to the laboratory results being obtained in England by the activated sludge process, these results having been presented by Messrs. Lockett and Ardern to the Manchester Section of the Society of Chemical Industry May 30, 1914.

After correspondence with Professor Gilbert J. Fowler of the Manchester University, the discoverer of the process, and learning from him the great possibilities of the process, we decided to conduct experiments, under his direction, of greater magnitude than had theretofore been undertaken.

To that end we improvised one of the tanks which had been used for testing chemical precipitation into a tank for trying the activated sludge process by the "fill and draw" method.

This was placed in operation sometime in March of the present year, and has been operating under varied conditions up to the present time. A full description of this tank and the results obtained appear in Engineering News, July 15, 1915, page 134, and need not be here repeated.

The operation of this tank, together with two smaller experimental tanks being operated at the same time, clearly demonstrated that it was possible to treat the sewage of Milwaukee by the activated sludge process on the "fill and draw" method, when the temperature of the sewage was 50° F. or over, at less cost than by any other process with which we had been experimenting, taking into consideration the character of effluent obtained.

Having determined the availability of the "fill and draw" method, we determined to try the "continuous flow" method. To that end the other chemical precipitation tank which stands alongside of the "fill and draw" tank, and of the same dimensions, was revised and put in operation. A detail of this tank is shown in the Engineering News, July 15, 1915, page 137.

Activated sludge was obtained for seeding this tank partially from the Imhoff tank and from fresh sewage. The Imhoff tank sludge, which is anaerobic, and which must be converted into aerobic sludge before activated sludge is produced, was run into the new tank; to this was added fresh sewage every eight or ten hours, and the mixture aerated by blowing air through it under about 5 pounds pressure. At the end of six or eight hours the air was turned off, sludge allowed to settle, the supernatant liquor drawn off, fresh sewage added to the capacity of the tank and the aeration repeated.

This process was continued until the tank contained about 30% of its capacity of good activated sludge. It required about 33 days to seed this tank in the manner described, whereupon it was started upon the "continuous flow" method. This was begun during the first week in July of this year and has been continued without material interruptions since.

From the beginning of the tests remarkable results were secured. With a rough screened sewage containing from one to seven millions

bacteria per c. c., 250 p. p. m. of suspended matter, 30 p. p. m. organic nitrogen and 120 p. p. m. oxygen consumed, an effluent was produced containing a 99% removal of bacteria and suspended matters, 12 to 14 p. p. m. nitrates, stable after 5 days and clear as the lake water, leaving a sludge containing 5.45% of ammonia, 1.34% of available phosphoric acid and 0.23% of potash, worth as a fertilizer $9.00 a ton based on dry weight.

This was accomplished with 1.77 cubic feet of air per gallon of sewage treated, costing $4.43 per million gallons based on air at $2.50 per million cubic feet compressed to 5 pounds pressure, which is our guaranteed cost where large units are used, and includes all overhead charges and boiler room labor, but not outside plant or engine room labor. Experiments now underway indicate that the volume of air can be very much reduced.

In considering the cost of this process the character of effluent obtained must not be lost sight of. The effluent above described is of far higher standard than any yet obtained from any of the processes with which experiments have been conducted at the Milwaukee testing station, and much higher than is ordinarily required. If the standard is reduced the cost will be reduced in direct ratio.

In view of the foregoing record of results obtained by this process, either by the "fill and draw" or "continuous flow" method it is not surprising that the Sewerage Commission felt warranted in expending $65.000.00 trying out the process on a large size unit, before adopting it as a plant which would ultimately cost in the neighborhood of three millions of dollars.

One of the principle reasons for building the large unit was to determine how much low temperatures of the winter would affect the process, what methods would have to be used to overcome this effect and what they would cost. The foregoing results have all been obtained with sewages varying in temperatures from 50° F. to 70° F., whereas the winter sewages run down to 42° F. for short periods. It is well known that low temperatures seriously affect the efficiency of nitrifying organisms, but to what extent cannot be determined until a fair trial is made, and our contemplated plant may show that some artificial heat will have to be applied to some portion of the process during the extreme low temperature periods.

Description of Plant.

Sheet No. 1 is a plan of the general layout of the plant, which consists of eleven circular reinforced concrete tanks 30 feet inside diameter by 13 feet maximum depth, supported upon a pile foundation due to the instability of the soil. Tanks 1 to 6, inclusive, are the aerating tanks in which the sewage mixed with the activated sludge is aerated by means of air forced in under 5 pounds pressure. Tank 9 is the sedimentation tank, and tanks 10 and 11 are the activated sludge tanks.

Sheet No. 2, is a detail of the aerating tanks showing the curved baffles, the manner of sloping the bottom of the running through channels so as to avoid the deposition of sludge and the manner of placing the air diffusers, details of the castings in which the diffusers are set, and the manner of connecting the air pipes with these castings.

Sheet No. 5 shows the details of the sedimentation tank, which is the only tank to be roofed over. The roof is necessary to prevent ice forming about the edges of the circular weir, which would set up uneven currents. This tank has a radial flow, and is designed for a 25-minute sedimentation period at two-million-gallon rate.

The two sludge tanks are similar to the aerating tanks except that they are each made into two separate compartments by stop planks connecting the two ends of the baffle walls. The air pipes and diffusers are placed in the same number and manner as in the aerating tanks.

Wooden rectangular troughs are built part way around each tank to control the direction of the flow of liquor, and stop planks are arranged so that any one or series of tanks can be cut out. The sewage from 250,000 people, to which is added the sewage from the packing house district, tanning factories, and many other large industrial establishments, passes out to the lake through a 20-feet-wide open channel alongside of the proposed plant.

In this channel a weir is constructed 20.35 feet long, which maintains a depth of about 3 feet of liquor for 40 feet back of the weir. This is the grit chamber in which the heavier solids from the street washings are deposited, as the sewers connected with this large intercepting sewer are of the combined type.

Above the weir, just mentioned, the liquor for the plant is taken off through a wooden rectangular channel, in which a weir is built, having the same elevation as the long weir, and an overflow weir to regulate the head over the plant weir. A liquid recording gauge will be placed back of the plant weir to measure the flow of liquor through the plant.

The weirs have been so arranged as to provide a flow through the plant to correspond with the fluctuations of flow through the main sewer, and the air applied to the sewage will be automatically regulated to correspond with this flow. Self-recording air meters will be installed to determine the volume and pressure of air used.

The sewage, after passing the plant weir, enters tank No. 1, where it comes into immediate contact with the air and the activated sludge, with which the tank has been originally seeded. It is designed to use 25% of this activated sludge at first and to increase or diminish it as the operation shows necessary to get the most economical results.

Passing thru tank No. 1 the liquor, mixed with the sludge, enters tank No. 2, when it is again aerated and further mixed with sludge contained in that tank, and so continues until it passes, with the sludge mixed with it, into the center of channel of tank No. 9. Here the sludge settles out to the bottom of the tank, the clear liquor passing over the circumferential weir to the lake.

The sludge settles to a deep well built in the bottom of the settling tank, and is discharged by gravity into sludge tank No. 10 or 11 where it is aerated for such a period as may be necessary to maintain the nitrogen cycle. From these sludge tanks the sludge passes to an 18-inch cast iron pipe sunk vertically in the ground with its base about 28 feet below the height of the liquid in the sludge tank, and from this pipe it is pumped by air into the fresh liquor trough, entering No. 1 tank with the raw sewage and again passing through the process.

That portion of the activated sludge in excess of what is necessary to maintain the proper percentage in the aerating tanks is pumped out of the sludge tanks from time to time and dewatered and will be used as a fertilizer. The method of dewatering has not yet been decided upon, but will probably be by means of the sludge press or vacuum wheel.

The deep chambers connected with the settling tank and sludge tanks are for the purpose of dewatering the sludge as much as possible by weight, and thus avoiding the pumping of unnecessary liquor through the process.

It has been found by the experiments conducted that the success of the "continuous flow" method depends upon maintaining good activated sludge at all times in the tanks treating the fresh liquor. By aerating the sludge to a higher degree than the whole body of the liquor, air is saved, because only 25% of the entire mixture is thus given additional aeration.

The plant, as designed, can treat 1,600,000 gallons of sewage per day with a four hours' period of aeration and with 25% activated sludge content. From present indications it will be able to treat the sewage satisfactorily, when the temperature is 50° F. or over, at a much higher rate, but this is yet to be determined on the large scale.

In order to overcome some of the effects of low temperature it is designed to pass the condensing water from the present sewage station adjacent to the new plant through coils of pipe hung to the inside perimeter of the two sludge tanks, inducing circulation by a circulating pump built in the condenser discharge line. This water is now discharged into the river at a temperature of about 100° F.

The power plant for producing the air necessary for operating the plant consists of two positive pressure rotary blowers each having a capacity of 2400 cubic feet of free air per minute compressed to 6 pounds of pressure, and belt driven from two A. C. variable speed motors each of 75 b. h. p. equipped with a drum controller and totally enclosed three-pole oil switch with inverse coils and a low voltage release attachment.

Only one unit will be required for operating the plant. Two are provided to avoid possible interruptions. The current will be secured from the local company.

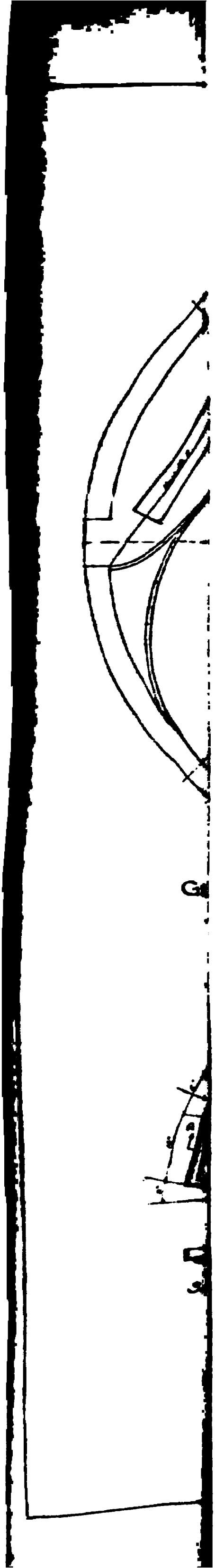
One of the questions which would immediately arise in the mind of the engineer is why were circular tanks designed in preference to rectangular. These tanks were designed before any results had been obtained from the "continuous flow" method, and the writer felt there were only two processes available for satisfactorily treat-

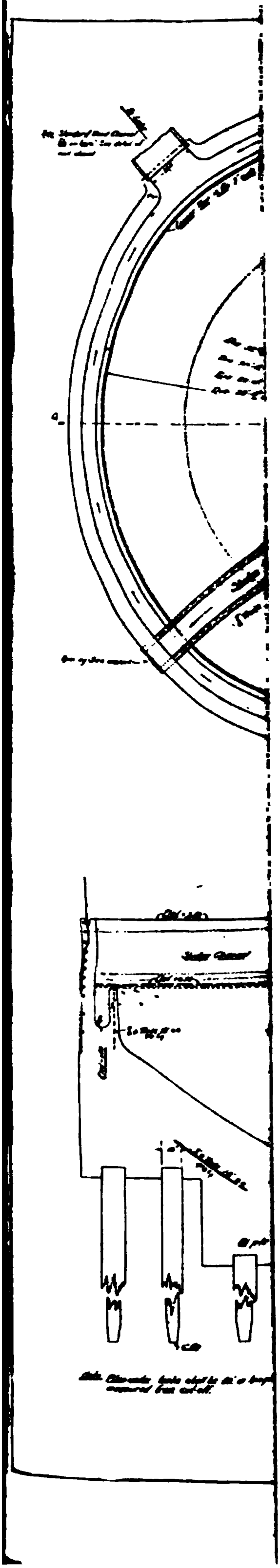
ing the sewage of Milwaukee; the activated sludge process ' "continuous flow," or fine screening followed by Imhoff tank s mentation followed by chlorination. If the former process prc a failure the latter would have to be adopted. The tanks w therefore, designed so that they could be used as the digest chambers for an Imhoff tank installation by removing the slop bottoms and baffle walls. By referring to detail of bottom of ta on Sheet No. 2 it will be seen that provision has been made : removing this concrete slope without disturbing the balance of t concrete bottom, by placing a paper joint between the two laye of concrete.

It is quite probable that rectangular tanks will better fit tl conditions required to successfully carry on the process, for severa reasons. One is that the air diffusers can be placed across suc a tank at right angles to the direction of flow, thus avoiding pos sible short circuiting of the liquor, another is the better convenienc of placing the air piping system and avoiding placing any pipes i concrete, and another is cheaper forms for construction. But whatever form of tank designed the width of the running through channel should not exceed 6 to 8 feet to get the most economical disposition of the air.

Many experiments have been conducted with a view of determining the best form of air diffuser, and others are now being carried on. So far the "Filtros" plate seems to give the best result. This is a composition of quartz sand and some character of cement to bind it together. The sand is ground to an uniform coefficient to give any desired porosity and, after adding the cement, is burned in a furnace. The plates come any size or shape desired and at any thickness. In the Milwaukee plant a plate 12 inches square by 1½ inches thick is being used and known as type 5-3 which has a capacity for passing 2 cubic feet of air per square foot at 2 inches water pressure, the porosity being 33.27% by voids. This material is manufactured by the General Filtration Co. Inc. of Rochester, N. Y.

It has been found very important to maintain as far as possible an even diffusion of air throughout the body of the liquor. That is, every square foot of plate should contribute its share of free air. To this end, as will be seen in the details of the castings on sheet No. 4, orifices are provided to be set in the casting under





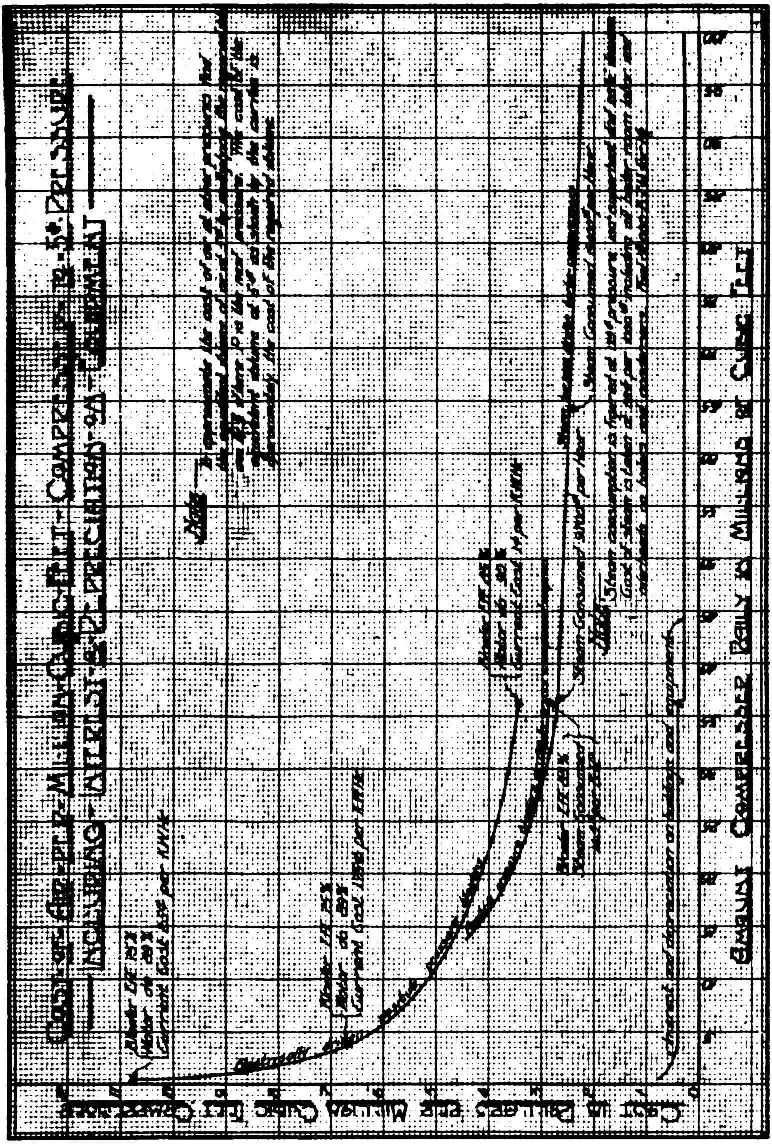


Plate 1.

each Filtros plate. Each orifice is designed to pass the required volume of air under a predetermined pressure.

Cost.

Of course, one of the most important factors to be determined in treating sewage by the activated sludge process is the cost, and the writer presents herewith an estimate of the cost so far as it has been determined from the experiments so far conducted.

In considering this phase of the question it should be first realized that such effects upon cost as low temperatures might have has not been determined; that, with this exception, sufficient data have been secured to accurately determine how much air is required to treat the sewage and sludge to produce a certain standard effluent from the Milwaukee sewage, and guarantees from well known manufacturers of blowers, engines, turbines and motors have been secured as to the efficiency of the several apparatus they will undertake to furnish for the final treatment plant.

General dimensions of aerating, sludge and settling tanks have been determined with reasonable accuracy based upon the various periods of aeration and sludge content shown upon the following diagrams. These diagrams have all been prepared for determining the cost of treating a daily average of 50 millions of gallons of sewage at Milwaukee, with coal worth one cent per 82,000 B. t. u., the price now being paid by the City's Water Department, but from the diagrams the cost for other rates of flow can be determined.

It is clearly demonstrated, however, that the smaller the plant the higher the cost for treatment due to the less efficiency in operating small size blowers, and reciprocating engines and small motors, instead of large size blowers, steam turbines or large motors. It may be that this cost can be considerably reduced by using oil or gas engines in driving the smaller units.

Plate 1 is a diagram showing the cost of producing air compressed to 5 pounds pressure by either an electric motor, Corliss compound engine or steam turbine. The cost of the electric current is based upon the costs for which the local company has agreed to furnish the required service.

Plate 2 is a diagram showing the cost of producing the air per million gallons treated per day under varied conditions as to period

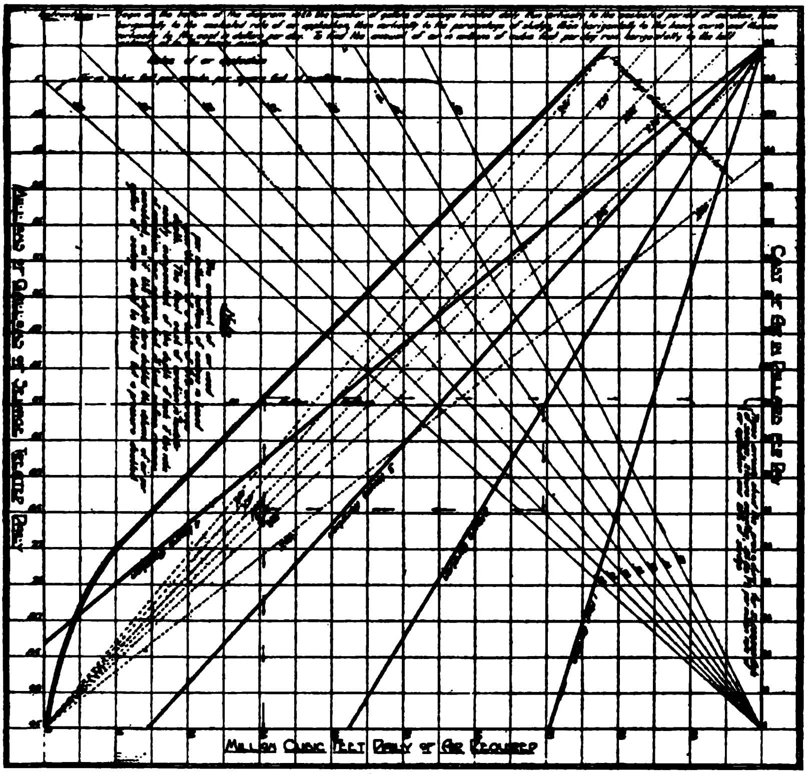


Plate 2

of aeration, rate of air application per square foot of tank surface and percentage of activated sludge maintained in the tanks. This cost is taken from Plate 1, and includes all boiler room labor and all overhead charges such as interest, sinking fund and depreciation.

Plate 3 is a combination of the data contained in Plates 1 and 2, also includes the cost of the plant for treating the sewage, which cost includes all overhead charges such as interest, sinking fund and depreciation. The only labor cost included is boiler room labor, the engine room and plant labor not being included for want of sufficient information.

These diagrams are based upon rectangular tanks holding an average depth of 9 feet of liquor, the depth which has so far seemed most applicable to the Milwaukee situation.

In Milwaukee so far the most satisfactory results have been obtained by using 0.25 cubic feet of air per minute per square foot of tank surface, a period of 4 hours aeration with a sludge content of 25%. By referring to Plate 3 it will be seen that this treatment will cost $5.30 per million gallons treated, exclusive of engine room and plant labor, and the disposal of the sludge.

If a lower standard of effluent is required and a 3-hour period of aeration only is required, with 20% sludge content and the same rate of air supply, the cost will be seen to be $3.95 per million gallons treated.

The writer believes he is warranted in the statement that the above costs are much below the cost of producing an equal standard of effluent from any other process of sewage treatment applicable to a large United States municipality.

Considerable attention has been given to the sludge disposal problem and the question has been taken up with two firms who are in the business of producing fertilizers from by-products. One of these firms gives the following analysis of a representative sample of the sludge:

Nitrogen	4.48%
Fat	7.60%
Total Phosphoric Acid	1.84%
Insoluble Phosphoric Acid	0.50%
Available Phosphoric Acid	1.34%
Ammonia	5.45%
Potash	0.23%

It gives the present value of this sludge as a fertilizer the sum of $9.00 per ton based upon its dry content, and states that it is the only sewage sludge with which it has had any acquaintance that gives sufficient value to warrant handling. It further estimates the cost of recovering the sludge, that is dewatering and drying, as $3.00 per dry ton. From all the information so far available, which is far from being reliable, about one ton of dry sludge will result from treating one million gallons of Milwaukee sewage.

At any rate it seems quite within the bounds of reason to anticipate that there will be sufficient recoverable value in the sludge to pay for its final disposition at least, so that the cost of this portion of the process need not be taken into consideration when comparing it with the cost of treating sewage by any other process.

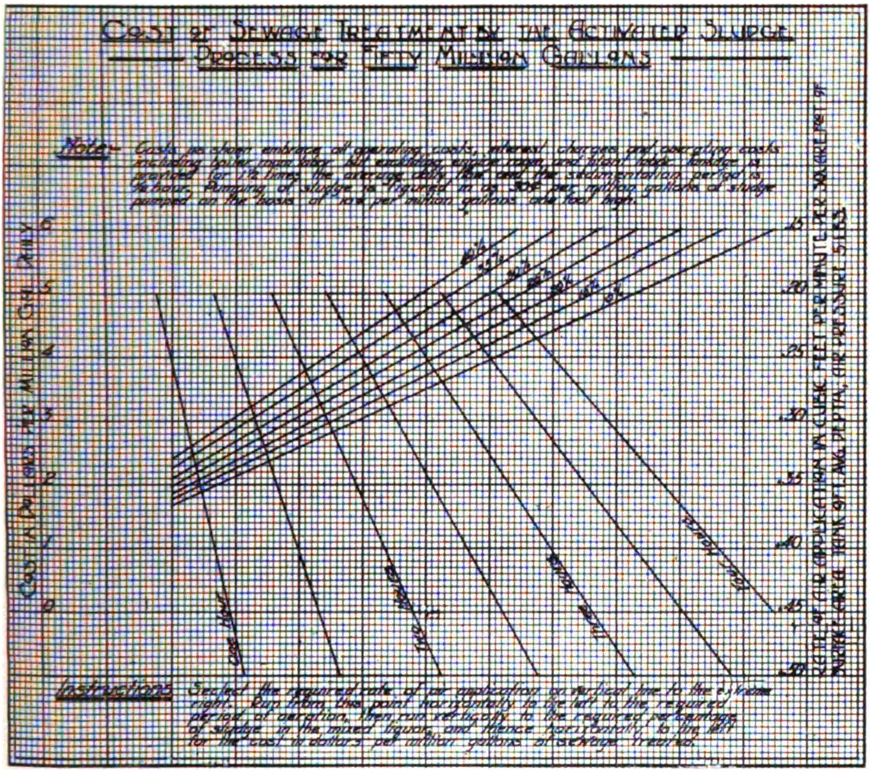


Plate 3

It might be stated that the companies have declared their willingness to take all the sludge, corresponding to the sample submitted, which could be furnished them, and that they would be quite willing to take it either with 50 to 60% moisture or less and pay us upon the basis of the dry content, charging us for the cost of drying.

The sludge is far easier dewatered than is the Imhoff tank sludge, and is free of odor as is the entire process of treatment.

To show the bacterial efficiency of the process the following table is given, showing several representative samples taken from the day's run of the "fill and draw" tank over a period of two months. This particular table is here inserted to bring out clearly the remarkable effect on the bacteria for the different periods of aeration. The tank was working with an activated sludge content of from 12 to 14%:

Date		No. of days stable after 4½ hours aeration.	No. of cubic feet of air per square foot of tank surface.	No. of cubic feet of air per gallon of sewage treated.	Hours of Aeration. No. of Bacteria per C.C. at 37°C. Raw Sewage Activated Sludge Tank.					Percentage of removal of 37°C. Bacteria.
					0	1½	2½	3½	4½	
May	11	5—	0.30	1.47	160,000	1,000	1,000	1,000	1,000	99—
June	2	5—	0.28	1.41	230,000	1,000	1,000	1,000	1,000	99—
June	8	5—	0.39	1.90	240,000	12,000	5,000	3,000	1,000	99—
June	12	5—	0.30	1.49	110,000	6,000	5,000	1,000	1,000	99—
July	22	5—	0.35	1.72	300,000	15,000	9,000	3,000	2,000	99—

These results indicate that most of the work is done in 1½ to 2½ hours so far as the removal of the bacteria is concerned, although a longer period of aeration is required to secure a stable effluent. An 1½ hours' aeration gives, in every case, a clear effluent providing the liquor comes in contact, during the period, with 12% or more of activated sludge, but, so far, it has not been possible to maintain the sludge in an activated condition with only 1½ hours' aeration.

Now what is the "activated sludge" process? The writer's definition is, the scrubbing of sewage liquor by means of artificial air injected throughout its mass at low pressure and of sufficient volume to separate suspended matters and colloids, which form a sludge kept in constant and thorough agitation throughout the body of the liquor. The sludge, thus kept in contact with the liquor, must contain sufficient reducing and nitrifying organisms, and adequate food and lodging therefor, to break down the organic nitrogen into free ammonia and nitrogen, and to oxidize these to nitrates.

The above is the engineering definition, and suggests the vital points which the engineer must consider in designing the plant. The definition given by our Chief Chemist, Mr. William R. Copeland, is much more scientific and is as follows:—

"The sludge contained in sewage and consisting for the most part of organic matter, when agitated with air for a sufficient period, assumes a flocculent appearance very similar to little pieces of sponge. Bacteria gather in these flocculi in immense numbers, some of them

having been strained out of the sewage and others developed by natural growth. Among the latter are species which possess the power of decomposing organic matter, especially of an albuminoid or nitrogeneous nature, setting the nitrogen free, and others absorbing this nitrogen converting it into nitrites and nitrates."

"These biological processes require time, air and a favorable environment, such as suitable temperature, food supply and sufficient agitation to distribute them through all parts of the sewage."

Before satisfactory results can be obtained by the process the sludge must be activated. That is, the free ammonia nitrogen must be changed to nitrate nitrogen, or as we briefly term it, the nitrogen cycle must be established. This requires continuously aerating the sludge, while intermittently adding fresh sewage, for several days until it becomes quite brown in color and from which a clear limpid liquor can be drawn.

It has been found in our experiments that a clear effluent, with a 90%, or over, reduction of bacteria, can be secured without establishing the nitrogen cycle, but such an effluent is not stable for five days without dilution.

It is surprising how rapidly this process of sewage treatment has been taken up in an experimental way both in England and the United States. Within the last nine months ten experimental stations in the United States and one in Canada have been studying the process. Mr. M. N. Baker, in *Engineering News* of July 22, 1915, page 164, gives a very interesting statement of what has been done at these several points.

Prof. Edward Bartow, Director of the Illinois State Water Survey, has conducted a very interesting series of experiments at the University of Illinois. His paper appearing in the *Journal of Industrial and Engineering Chemistry,* April 1915, is one of the best descriptions of the process and the results obtained which has come to the notice of the writer, and he advises those interested to secure a copy of this paper.

Mr. Leslie C. Frank of the United States Public Health Service, has secured letters patent covering the process, and has dedicated the patent to the citizens of United States, thus protecting our municipalities against royalties. Mr. Frank is to be congratulated

for this act, which will prevent a repetition of the litigation experienced by many American municipalities who adopted septic tank treatment.

In conclusion the writer believes the activated sludge process is the best and cheapest process for treating sewage where a high standard of effluent is required, and that, as it becomes better developed, it will supplant sedimentation and sprinkling filters.

Its adaptability for treating sewage to any required standard makes it particularly attractive. The cost being in direct proportion to the standard required makes it come within the means of many of the smaller municipalities which would not be able to meet the first cost of sprinkling filters. The fact that the sludge is valuable as a fertilizer meets the popular conservation propaganda, and helps pay the operating charges.

It might not be out of place here to warn the young practicing engineer against advising his clients to adopt this process and then designing a plant before he becomes thoroughly acquainted with the principles involved. Such a procedure will result in probable failure and chagrin to him and an unwarranted reflection upon the ability and judgment of his profession. He better stick to the old processes until the problems connected with this new one are pretty well solved by those who have the facilities for conducting experiments.

DISCUSSION.

MR. TRIBUS: May I ask Mr. Hatton if he will tell us as to the prices of the sludge, whether that $9.00 and $12.00 was for the sludge including the fat, or whether he has had any figure as to the cost of removing the fat, which, of course, must be done to make it profitable?

MR. HATTON: In reply to that, I might say that the Sulzberger & Sons Company, which now operates a plant in the city of Chicago for the reduction of garbage, is one of the parties making us an offer of twelve dollars per dry ton, based on the nitrogen contained at $1.50 per unit and upon the grease content at $30.00 to $40.00 per ton. The three samples which we have sent them averaged $12.00 per ton complete, delivered anywhere. Now, Swift & Company, who also operate a large plant, is the concern that gave us

the nine dollars value per dry ton without including the fat content. I want to say, however, that my mission East this time has been to purchase machinery for the reduction of this sludge. I have made contracts for four different kinds of dewatering machines which we are going to put in our experimental plant. These include two different kinds of dryers, and we are going to operate these machines this winter and find out what is the cheapest way to reduce our sludge into a marketable fertilizer, and I think by four months from now I shall have some very valuable information in that respect for the members of the profession.

Mr. Folwell: I would like to ask a question. How much of the air used is actually used in oxidation, what percentage, and what percentage is used for the stirring of the sludge in sewage; and as part of the same question, what would be the comparative cost of doing the stirring by mechanical means, and thus reducing the amount of air which would have to be introduced.

Mr. Hatton: In reply to Mr. Folwell, I beg to say that we have been trying to find that out, and we have taken our oxygen requirements from the beginning of our tank to the end of our tank, but have not seen any difference in the oxygen requirements for the fresh sewage until it goes out of the tank, so we really can not tell how much we need for stirring and how much for the oxidation; but in many respects thruout the whole process air is valuable, and in conversation with Prof. Phelps, in Washington, a few days ago, that subject was taken up, and I think the Professor agreed with me as to the use of the air in the stirring devices; that the use of air is likely to be very much cheaper than any mechanical device.

Mr. Hering: It is a curious coincidence that, at the Erie meeting of this Society, in 1910, there was the first presentation on this side of the Atlantic of the Imhoff tank. This Society was the first body of engineers learning about the progress made in acquiring inoffensive sewage sludge production. It would be again curious to have today the first presentation before American engineers of the process which claims to be a further essential improvement in the process of sewage purification.

The aeration of sewage is by no means new. It was tried by the Massachusetts State Board of Health over twenty years ago,

and there it was, as you will find in reports, ruled out as inadvisable economically. It has been tried in England some five or six years ago. Prof. Fowler in Manchester was mentioned as having this on his mind for some years. Also in Germany they had made some experiments with this method. At all places it was found too expensive.

Recently a large number of experiments have been made in our country, as Mr. Hatton has mentioned. In Brooklyn it was found, according to the statement of the chief engineer, in a discussion on this subject in San Francisco, to be too expensive for practical purposes.

I do not think that we have as yet reached a final conclusion, and Mr. Hatton states that at the beginning of his paper. Municipalities are still awaiting further investigations, and particularly a trial thruout the winter months, before they can positively decide. Mr. Hatton mentions this precaution also at the end of his paper and thruout the same at several places.

There can be no question at all in my mind, or in the mind, I think, of anyone who has investigated the matter, that sewage can be purified by aeration. That is nothing more nor less than what is now done by the sprinkling filters; the sewage is purified by aeration, that is, by oxidation. The only question is how to oxidize it and which is the cheapest way to do it.

Mr. Watson, a prominent engineer in England, the engineer of Birmingham, who has designed and operated the largest sewage oxidation works in England, published a paper two or three years ago for one of the English engineering societies on aerating sewage in a sewer or in tanks by blowing air into the liquid thru perforations in pipes. It was done to prevent sewage from becoming putrescent. The same recommendation has been made on other occasions, and about the same time. So I think we are on the right line, and I think Mr. Hatton is to be congratulated that he has done so much work in this matter, and has done it so well, being supported by a very liberal appropriation on the part of the city of Milwaukee. There will be no question, after he gets thru, as to what the merits of this aeration of sewage, both its liquid and its sludge.

To aerate the sludge is rather novel, and its introduction will be decided on the question of economy. They tried it in Berlin

at the large experiment station, and found it was cheaper to let the sludge be decomposed in Imhoff tanks than by blowing air thru it. The expense of aeration should not be undervalued.

Now, let me say a word about a fundamental matter which is often overlooked. The ordinary decomposition of sludge as we see it in septic tanks has an offensive odor. That offensive odor is caused chiefly by the bacteria which generate sulphureted hydrogen, and throw off gases which have a very pronounced disagreeable smell. This gas is produced by anaerobic bacteria, as was mentioned today, and we call this process putrefaction. Aerobic bacteria decompose dead organic matter in the presence of air, as in sprinkling filters and sand filters, also in activated sludge. They produce gases which do not smell and therefore whenever you have bacteria which live and prosper in air containing oxygen, you get an inoffensive sludge and we call the process oxidation. The Imhoff process is neither putrefaction nor oxidation and that is the point to which I wanted to call your attention. The sludge is without question inoffensive; there is no more odor to it than from ordinary humus, our garden soil, and it is very similar to it in other respects. It is a different process, and today we have no name for it. It is not putrefaction, yet it is the work of anaerobic bacteria. It is not oxidation because there is practically no oxygen present. Therefore, it is a new process and no name has as yet been found for it. I think that this ought to be better known in order to better understand the process which is taking place in the Imhoff tank.

I have no doubt that in summer and in those parts of our country where the temperature of sewage can be kept, as Mr. Hatton says, above 50 degrees, this method, other things being equal, and its economy being sufficient, it is going to stay. Whether our northern climates, where we have to combat the winter temperatures, will find the economy of activation sufficient, remains yet to be settled. Nevertheless, I think we have again advanced a step in solving one of the most important questions with which the sewerage engineer has had to deal.

RE-AERATION AS A FACTOR IN THE SELF-PURIFICATION OF STREAMS.

By EARLE B. PHELPS, Professor of Chemistry, Hygienic Laboratory, U. S. Public Health Service, Washington, D. C.

In this age of practical conservation of natural resources, two opposing theories of the function of streams have become merged into a generally accepted principle. The ideal of streams of pristine purity has been abandoned of necessity. It is recognized that even without wilful and purposeful pollution, in fact, after the application of all reasonable protective measures, streams draining populous areas will still be too seriously polluted to permit their use for domestic water supply without purification. It is equally well recognized that uncontrolled stream pollution may so overburden the stream as to result in a definite economic loss to the community as a whole. The supposedly utilitarian argument for the unlimited use of streams to carry off all drainage and waste, has therefore fallen by its own reasoning, for such use is not, in the long run, utilitarian or economic.

From the merger of these two views, the ideal and the crudely practical, there has come this principle.

Conservation of natural resources demands that the greatest possible advantageous utilization be made of the various valuable properties of a stream. This may include such uses as navigation, drainage and irrigation, domestic water supply, fishing as an industry, pleasurable and health-giving enjoyment by the people in such forms as boating, bathing and fishing, the disposal of sewage and waste, the enjoyment of scenic beauty and various minor uses. These uses may all be indulged without further restriction than that the less important shall not interfere with or curtail the more important, the importance of any usage being measured in broad economic terms of public welfare.

While such a principle will readily meet with common approval it falls short of furnishing a satisfactory general solution to the problem because there is no general problem. There are rather a large

number of specific problems, differing among themselves in the various possible uses of the stream and each one requiring special study in the application of the general principle of conservation. In the case of the Niagara for example, the enjoyment of scenic beauty exceeds all other interests and will be protected even at great sacrifice in possible utilization of power. In Pennsylvania, on the other hand, the courts find that the drainage of coal mines is of paramount interest to the State and is a legitimate use of streams even though other valuable uses be destroyed thereby.

Furthermore, the general principle does not directly meet the special needs of the individual case, in that the factors of the local problem are constantly shifting ones. Growing populations; the variable but generally increasing value put upon public health, comfort and pleasure; the decreasing cost of sewage and waste disposal; the possibility of alternative but more costly water supplies, or of new and simpler processes of water purification, all tend to modify the terms of that which we have denoted the greatest possible advantageous utilization of the various valuable properties of a stream. For example, a new and greatly superior process of sewage disposal, and this example is chosen because of the liklihood of its practical realization in the near future, may make sewage disposal economically desirable under conditions that today leave it undesirable.

One of the few fixed and determinable factors in any specific case, and, curiously, the one of which we know the least, is the capacity of the stream itself to receive and dispose of organic pollution without reducing its own physical condition below specified point upon the nuisance scale. One may go further and state that not only is this capacity determinable in any given case, but the problem is capable of a general solution for all streams, the solution involving constants, equally determinable for various stream types and conditions.

Sewage and waste disposal by dilution, in so far as it is a process of purification and not one destructive of stream values, depends upon the self-purification of the stream. It is almost the universal process in this country, considering the population which it serves, and yet it has received almost no scientific attention or study.

In the present discussion of re-areation as a factor in the self-purification of streams certain underlying principles will be stated

and discussed for the purpose of establishing the present status of our information and the proper direction of future study.

1. Pure water exposed to the air, at given temperature, will dissolve atmospheric oxygen up to a maximum amount, this value being known as the saturation value.

The solubility of a gas in water is proportional to the gas pressure. Since the oxygen pressure in the air is approximately one-fifth an atmosphere, the true solubility of oxygen in water exposed to pure oxygen at atmospheric pressure, is about five times as great as the so-called saturation value. In the presence of green plant life, exposure to nearly pure oxygen is frequently observed and oxygen values of several hundred per cent of saturation are frequently recorded. A correct knowledge of the true physical relation existing is quite necessary to the understanding of these apparently abnormal results which have often in the past been ascribed to faulty chemical analysis. The solubility of oxygen is also a temperature function. Tables of saturation values are to be found in any standard work on water analysis. Approximately ten parts by weight of oxygen will dissolve in one million parts of water at 16° C. and the solubility increases roughly by about 2% for each degree centigrade decrease in temperature and vice versa.

2. Self-purification in a polluted stream is the result of the biochemical oxidation of organic matter and requires oxygen for its consummation. The more concentrated the organic matter the greater the rate of oxygen depletion.

American sewages have a biological oxygen demand of from two to four hundred parts per million. This means that if diluted with saturated water at 16° C. they would exhaust the oxygen supply of that water in dilution ratios of one part of sewage in from 20 to 40 parts of water. With greater dilutions corresponding partial oxygen depletion will result.

3. A stream saturated with oxygen will withdraw no more oxygen from the atmosphere. If partially depleted it absorbs additional atmospheric oxygen and the rate of such absorption or re-aeration while dependent upon many other factors is directly proportional to the state of depletion.

4. Under any given condition of pollution and re-aeration, a point of maximum oxygen depletition is reached, somewhere down-stream,

at which the rate of depletion and the rate of re-aeration are equal This will be termed the critical point since it determines the maximum effect of the pollution.

Above the critical point the oxygen content of the stream is diminishing, below it is increasing. The location of this point is evidently conditioned by the time of passage or by distance in hours rather than in miles. It is also a temperature function since depletition is accelerated by higher temperatures. As the velocity of stream flow is usually at its minimum during the hottest months, the critical point moves up-stream geographically rapidly with increasing temperatures.

5. The condition of the stream at the critical point, representing a balance between rate of depletition and rate of re-aeration, is a function of pollution and of re-aeration. Moreover, at constant temperature it is only a function of pollution and of re-aeration.

6. The capacity of a stream to dispose of sewage within any specified limits of nuisance is obviously measured by the condition of the stream at the critical point and is therefore a function of re-aeration and temperature only. Since it is at a minimum at maximum temperature and minimum stream flow, this capacity under fixed temperature and flow conditions becomes a function of re-aeration only.

7. The capacity of a stream for re-aeration under extreme conditions of high temperature and low stream flow measures its capacity to receive and dispose of sewage by self-purification within any prescribed limits of stream depreciation or nuisance.

In the past, although the relation of dissolved oxygen to the condition of a stream, as well as the fact of re-aeration, have been fully recognized, the relations set forth in the above principles have been partially or wholly overlooked because of imperfect ideas of the rôle of oxidation.

Mr. Hering evidently voiced the best opinion of the day when he wrote in 1887,* "Oxidation and total destruction of sewage by decomposition was for a long time thought to be the main cause for the clarification of polluted rivers. Today it is known to be but a minor cause, compared with dilution and subsidence."

*Quoted from Fuller, "Sewage Disposal," 1912. p. 227.

Observation made upon the old Michigan Canal showed that the sewage which, with a dilution in water of one cubic foot per second per thousand population, and after flowing 30 miles in about as many hours, was quite offensive, became inoffensive after discharge into the Desplaines and later into the Kankakee River and with dilution increased to about three feet. It was erroneously concluded that the same inoffensive condition would have been obtained throughout by a primary dilution in three second feet per thousand inhabitants.

Such a conclusion followed logically from the assumption of the minor importance of oxidation and the latter was apparently justified by the chemical methods of the times. Oxidation was measured in terms of nitrogen rather than oxygen and it is only within the past few years that the chemist has been in possession of methods which correctly record the progress of the oxidizing reaction.

In 1906 Hering and Fuller reported upon this matter further, and stated, *"The disposal of sewage by dilution depends upon the amount of oxygen in the diluting water being sufficient to prevent putrefaction of the organic matter in the sewage as the latter undergoes bacterial decomposition." Their recommendations were based upon results obtained in Massachusetts upon flowing streams, and were to the effect that a dilution of not less than 3.33 second feet per thousand population would be necessary, after the elimination of trades wastes. Throughout the discussion emphasis is laid upon the oxygen initially present in the dilution water.

The application of observational data, obtained upon running and comparative shallow streams where conditions are ideal for re-aeration, to deep canals with sluggish flow and minimum re-aeration conditions cannot but lead to unsatisfactory results. A large part of the residual oxygen found in streams of the former type can now be shown to have been derived from natural re-aeration. If it be assumed that such residual oxygen was initially present and had not been utilized by the sewage, the capacity of the sewage to consume oxygen is thereby underestimated and the application of the data to streams of the second type with deficient re-aeration will lead to insufficient dilution and a condition of nuisance not anticipated.

*Fuller. "Sewage Disposal," 1912. p. 252.

As early as 1900, Palmer* found the dissolved oxygen at the lower end of the sanitary canal in August to be 5.88% of saturation, increasing to 70% after passing the dam. Wisner*, reported in 1911, the frequent absence of oxygen for many miles above the lower dam at Lockport with a dilution of about 3.3 second feet per thousand. Passage over the dam increased the dissolved oxygen to about 19% of saturation. The relative importance of dilution and re-aeration will be appreciated, if it be noted that simple passage over the dam had the effect of a 25% increase in saturated dilution water, or was equivalent to raising the dilution from 3.3 to 4.1 second feet per thousand.

Numerous other examples of the same sort are to be found in the literature but sufficient quotations have been given to illustrate the point. Approaching the matter from the analytical standpoint and making use of the newer analytical methods the same facts may be demonstrated upon a quantitative basis. Normal American sewage* may be taken for the present discussion to have a biological oxygen demand of about 300 parts per million, or milligrams per liter. On this basis and assuming dilution in saturated water at 20° C. (68° F.) the sewage would totally exhaust the oxygen of the stream in a dilution of 5.04 second feet per thousand population. To preserve a residue of dissolved oxygen in the stream of 33%, of saturation, an extreme minimum for the prevention of nuisance, the dilution would have to be increased to 7.56 second feet. It is apparent, therefore, that where nuisance has not occurred in streams, at much less dilution, the re-aeration factor has been operative in replenishing the supply of oxygen.

The problem of the present deals not so much with present conditions as with the future. It is of the utmost importance to determine the future effect of gradually increasing pollutions upon any given stream. In connection with purification treatments it is also highly desirable to know what degree of stream improvement may be antic-

*Report on Streams Examination, Sanitary District of Chicago, 1903, p. 95A.

*Quoted by Fuller, "Sewage Disposal," 1912, p. 214.

*The term "Normal American Sewage" is employed by the writer in computations of this character to avoid the difficulties involved in the varying dilutions of sewages from American cities. All data obtained from analyses of sewages of known ratio of volume to contributing population are reduced to an equivalent analysis on the basis of 100 gallons per capita per day. This gives the normal sewage of that city. From these values computations are readily made in terms of population and it is not unreasonable to assume that the normal for cities of somewhat similar type will be similar, excluding from consideration, important or largely predominating industrial wastes.

ipated from any specified degree of purification in order that the cost of various treatments may be properly balanced against the benefits to be expected. Finally, there frequently arises the problem of the effect of a very large pollution of a hitherto unpolluted or slightly polluted area, following the location, for example, of new intercepting lines and discharge points. The essential elements of the specific and the general solution have been outlined, in the example just given. Examination of the extent of pollution at a given point, measured in terms of the new sewage chemistry which deals with oxygen relations, and of the degree of self-purification and amount of residual oxygen at some lower point, together with temperature and hydraulic data, furnish the basic facts. The oxygen requirement and rate of oxygen depletion are known. The condition of the lower station in the same terms is calculable. The actual condition compared with the calculated gives the re-aeration factor for the stretch. This must be determined for the same stretch over a considerable period of time in order to properly include the variation in hydraulic conditions. In particular the re-aeration is a function of depth, velocity of flow and degree of turbulence. Similar data may be obtained at the same time over other typical stretches and the relation of the re-aeration factor to other physical and hydraulic conditions noted. From such a comprehensive study there will be obtained eventually the necessary data for the determination of the re-aeration constant of the stream in question under various physical conditions. Then the result of increasing or decreasing pollution, always measured in proper terms of oxygen demand, will be readily calculable. Repetition of the study upon another stream will give similar data for that stream and also permit some study of the effect of stream type upon re-aeration. With accumulating data of this sort it is not unreasonable to anticipate that the fundamental constants will ultimately be derived with which the capacity of any stream to receive and dispose of sewage within stated nuisance limits may be determined in advance. Such constants will furnish the only rational basis upon which to estimate the effect of increasing or decreasing pollution, or in the degree of purification necessary or desirable in any case. As these matters have been shown to be of primary importance in any application of the principle of conservation to streams, the importance of work of this character is obvious.

In the foregoing discussion it will be noted that no reference has been made to either of two distinct phases of the pollution problem.

the matter of dangerous bacteria and that of sludge deposits. Both are separate and distinct problems capable of solution independently of the problem of oxygen supply and leading to nuisances of distinct character. The presence or absence of these factors does not influence the methods or conclusions of this discussion, although the matter of deposits does enter the analytical problem.

The determination of the re-aeration co-efficient of a stream has been undertaken for the first time in connection with investigation of the Ohio River now being made by the U. S. Public Health Service under the direction of P. A. Surgeon Wade H. Frost. The actual analytical problem is exceedingly complex and the mathematical reduction and analysis of the results is both complicated and laborious. The work has progressed to a point at which it is obvious that results of value and consistent with the theory here stated have been obtained.

An important conclusion of this study will be touched upon briefly in passing. Re-aeration is conditioned among other things by the degree of turbulence of the stream. In quiescant water a diffusion gradient is established which practically stops re-aeration. The effect of dams and rapids in increasing aeration is not so much dependent upon the momentary exposure of the water but is largely due to the mixing action whereby the diffusion gradient is broken up and re-aeration permitted to proceed. In artificial canals turbulence is avoided as largely as possible. The effect of a single dam upon de-aerated water has been shown to be equivalent to a large increase in initial dilution. Where dilution is for any reason limited, the capacity of sluggish and non-turbulent streams can be greatly augmented by providing an artificial turbulence at certain points in their course. Such turbulence need not be of the character of a fall, nor need it cause a serious loss of head. A number of mere overturns or "boils" will be found more efficient than a single large fall.

Summary.

In the development of the maximum economic use of a stream, its capacity to dispose of sewage and waste within any specified degree of depreciation or nuisance is a factor of first importance.

This capacity is limited by stream conditions and is a function of the capacity for re-aeration.

For this reason the dilution unit is an improper one for a discussion of nuisance and self-purification and results obtained upon one stream, expressed in such units, are not applicable to another.

Re-aeration is capable of experimental determination not only in single instances, but in terms of general applicability.

Its determination in such general terms involves laborious work of a hydraulic and analytical nature. A beginning has been made along this line in the Ohio River Investigation of the U. S. Public Health Service.

STREAM POLLUTION FROM SURFACE DRAINAGE AS THE LIMITING FACTOR IN SEWAGE PURIFICATION.

By GEORGE H. NORTON, City Engineer, Buffalo, N. Y.

Most great inland cities are situated upon the large rivers or bodies of water. Beyond the commerce which is the reason of their location, the vital relation of these waters to their adjacent cities lies in furnishing a potable water supply and in ultimately receiving their liquid wastes in drainage. Usually the size of these waters indicates large valleys, precluding the conveyance of drainage beyond this valley. It must, therefore, be expected that the discharge of the liquid wastes of the adjacent cities will be made into these waters after greater or lesser purification and that potable water supplies will be drawn from the same waters.

Usually these cities are surrounded by a fertile and well populated agricultural territory with many small villages making a potable water supply, taken from the small tributary drainage areas, so subject to local contamination as to be less dependable and desirable than a supply from the nearer and larger waters.

That some cities go to the wild and sparsely settled highlands near the source of the streams and others, precluded from such, have been obliged to depopulate and otherwise effectively police more fertile areas are sufficient admissions that surface drainage from ordinary agricultural districts is materially polluted.

While these observations are especially applicable to the cities situated upon the great rivers, they are also applicable to the population situated upon the Great Lakes and much of this great urban population upon the lakes and their connecting channels are now most vitally interested in this subject of pollution.

The Great Lakes are largely self-cleansing and would give excellent water supplies if not burdened with their great tributary population. The burden of these waters in self-purification is of two sources; surface contamination from their fertile drainage areas and concentrated pollution from great cities on their borders.

That the contiguous population receive these waters in their pristine purity, both sources of contamination must be eliminated. It is often asserted that the cities should cease their contribution to the general condition, which might be accomplished at immense cost, but little consideration has been given the general surface contamination.

Upon the fertile smaller tributary drainage areas will be found the farms and hamlets where the usual sanitary accommodations are those of privies from which the excrement flows away or is periodically spread upon the land. Throughout much of the year these are undoubtedly oxidized by natural processes and do not concern this discussion. Small villages, having commercial water supplies, drain into streams of sufficient size to prevent serious physical nuisance, but partially digested sludge is accumulated in mill-ponds and pools. In the northern climates, however, the winter period of three or four months makes dormant the natural aids, to be followed immediately by the greatest flood discharges cleaning the whole surface of its accumulations. These discharges often reach the equivalent of two inches or more of water over the entire drainage area. For purposes of illustration, assume that this flushing by spring freshets may bring down one-fourth of the year's accumulated filth of the drainage area or that one-fourth of 365 days, or 91 days, accumulation is brought down and that this occurs within a period of fifteen days, then there would be one-fifteenth of 91 days accumulation passing down each day or six days' accumulation of filth from this drainage area to pass into the great waters each day during the flood periods from sources outside the great cities situated upon them.

To apply this to a specific example, the Niagara River has upon its course an urban population of about 600,000. There enter it from the east two minor tributaries having a population upon their drainage areas of about 100,000. From the above reasoning there would enter from these tributaries during each of fifteen days a year, from flood discharge, a pollution equal to that normally entering from the cities along its course.

The fallacy of purification of this stream by exclusion of city sewage alone is apparent if, during fifteen days of each year, the condition remains substantially that of normal pollution.

There must be added to this the surface washings of the urban areas which, at present, seem entirely beyond reasonable limits of purification.

Another consideration remaining to the general condition of these waters is that of the accumulated flood discharges as affecting the whole body of lake waters.

A rise of one and one-half feet has occurred in a month in Lake Erie from spring flood discharges, representing an addition of one to two per cent of the whole contents in polluted surface drainage. This does not thoroughly admix, but remains somewhat adjacent to the shores and there represents a greater proportionate pollution.

This condition may be of utmost importance to several of the Lake cities situated at the mouths of comparatively small streams. Due cognizance is taken of the highly polluted condition of these small streams, and water intakes are located at a distance along the shore such that the dilution, perhaps supplemented by sewage treatment, will apparently ensure a safe supply and yet the accumulated discharge of some near small stream may, at times, produce a body of water which, under usual conditions of wind and current, may be brought to the intake. This possibility may well indicate the advisability of more thorough water treatment at a less expensive location or a lessened sewage treatment for the City with the same factor of safety secured.

It may be argued that this surface drainage has lost most of its pathogenic bacteria, and is, therefore, comparatively innocuous, but the medical profession is not yet prepared to say that this organic refuse, even without pathogenic bacteria, may not be a marked source of digestive ills.

Under the above assumptions and arguments the conclusion must be reached that any endeavor to improve these waters to a safe potable standard by removal of urban sewage alone, will be futile. Nor can it be assumed, within fair reason, that this effect of surface drainage can be eliminated as a practical or immediate probability. Until sanitary science and sentiment have made great strides, surface contamination must continue as a potent factor demanding treatment of potable water supplies and with such requirement the logical corollary is that only such treatment of municipal sewage is required as may prevent undue burden upon a water plant designed to meet the conditions of surface pollution.

Until sanitary science and education have made greater advance in the rural and suburban territories, the inherent menace of this drainage must be a limiting and controlling factor in any endeavor to render pure the larger bodies of water and to make them potably safe by remedies applied solely by the great municipal bodies along their borders.

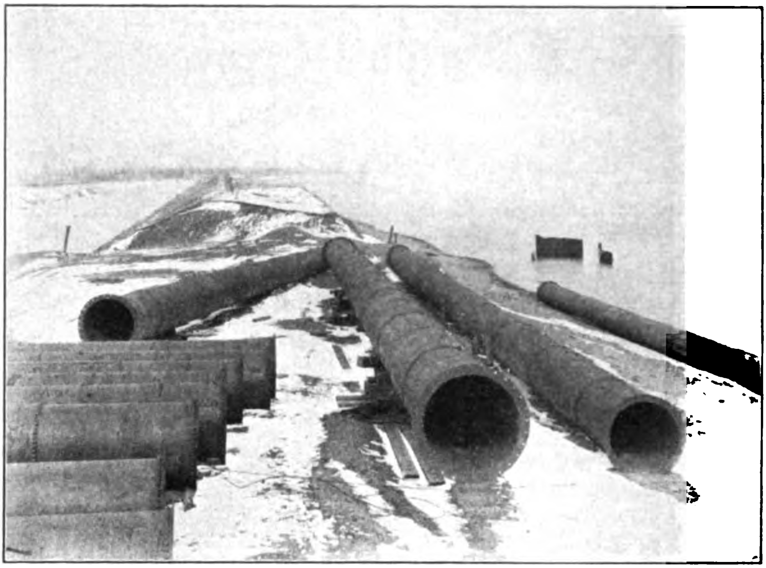
SOME NOTES ON HAMILTON WATERWORKS RECONSTRUCTION.

By A. F. MACALLUM, City Engineer.

The city of Hamilton, Ontario, completed its first waterworks system in 1859, which system was developed gradually to meet the growth of the city until 1912, when it was found that the rapid growth of the city necessitated the complete renewal of the entire system. At this time there were in operation four steam pumps having a combined discharge of thirteen and half million gallons (imperial) per 24 hours and three mains to the city, 18-inch, 20-inch and 30-inch respectively. Two of these pumps and the 18-inch main were installed and in continuous use since 1859, and these pumps, of the vertical walking beam plunger type, are today somewhat of a curiosity. These old pumps are yet in commission, but used only in the event of interruption to the electrically driven turbine pumps installed during the reconstruction, and when the other two and newer steam pumps cannot meet the demand.

Hamilton, Ontario, lies at the westerly end of Lake Ontario, where at its extreme end a sand ridge cuts off the Lake from the Burlington Bay, on the shores of which the city lies. Owing to its location and this sand ridge, thru which a short canal is cut to the lake, combined with the fact that most of the sewage from the city is treated at disposal works before entering the bay, it has never been found necessary to treat the water taken by the intakes from Lake Ontario. This places this city in the unique position of being about the only city drawing water from the Lower Great Lakes that has not to treat its water supply. In connection with the original installation two intakes extended into the lake, one cast iron, 20 inches in diameter, for a distance of 1,000 feet and a wooden box intake three feet square a distance of three hundred feet, each having its inner end in a settling basin from which wooden conduits lead to the wells at the pumping station. It is interesting to note that one of these wooden conduits placed in 1859 was found to be in first class condition after 55 years service.

It was decided to construct a new intake, four feet in diameter and 2,100 feet in length, which would bring it to a depth of 32



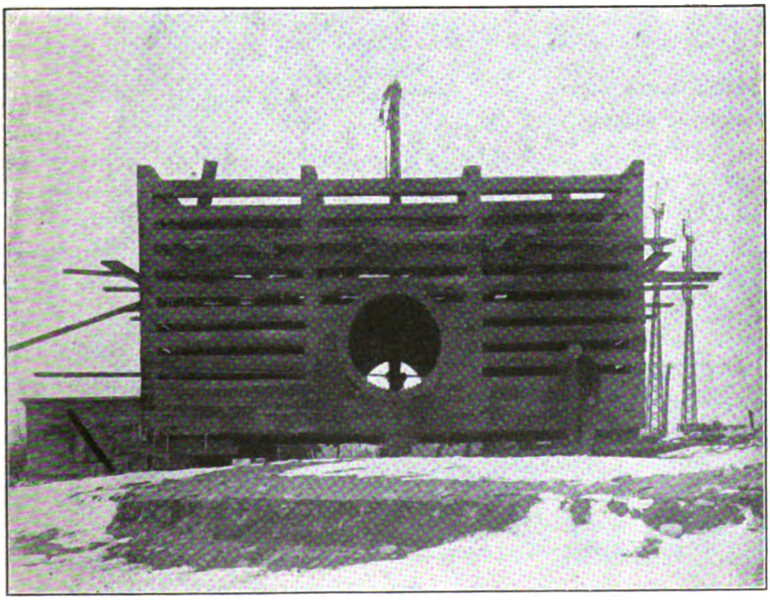
The 48-inch steel intake pipe in lengths of 140 feet on the shore of Lake Ontario.

feet of water in the lake. This steel intake pipe, including intake piece, sluice valve and expansion joints, cost $20,520 delivered on the site and riveted in lengths approximately one hundred and forty feet, on the ends of which were flanged pieces. The price mentioned includes also the lead gaskets and bolts.

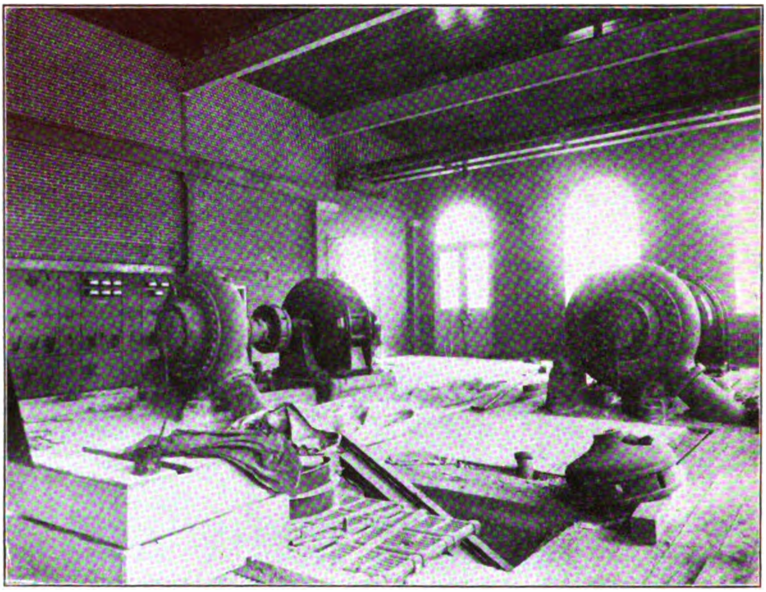
The accepted tender for laying this pipe was $35,000 which included the building and placing of the intake crib, and a concrete valve chamber and house at the settling basin end. As ice ridges formed out in the Lake for a distance of about 1,000 feet and in some places thirty feet high, to protect the pipe it was necessary to lay the pipe in trench on the lake bottom so that when filled in again the pipe was covered. Concrete in bags was placed around the pipe for 300 feet from the shore line as an added precaution. Four piles were driven in the trench in such a position that when a 140-foot section was floated into position two piles would be at each end of the section. Across the two piles at each end a sill was bolted at grade and the pipe was lowered to rest upon these sills and held in position there by wooden blocks on either side. A

cap was bolted across the two piles over the pipe after the section had been bolted to the preceding section by the divers. Besides alinement, the object in driving these piles was twofold; first, for ease in joining up two sections clear of the sand, and secondly, to prevent as much as possible, divers not bolting up the lower sections of the pipes because of difficulty of access. As there was practically little possibility of scour on account of the method of construction adopted, it was not considered necessary to space the piles closer, and I may say that the above arrangement has proved quite satisfactory.

In an examination of the plans for intake cribs adopted by the cities on the Great Lakes, it was found that the minimum size was 40 feet square and of sufficient height that the mouth of the intake facing upwards was at least seven feet above the bed of the lake. This minimum size I did not consider necessary, but designed the intake crib to be 24 feet square, placing rip-rap around the outside, and this has since been found quite sufficient. No iron was exposed about the intake openings, but these were constructed with oak plank to prevent the formation of anchor ice. In the gate-valve



The intake crib before launching.



The beach or main pumping station during construction, showing two pumping units.

house were placed fish screens for obvious reasons. A reinforced concrete conduit 4 feet in diameter and 2,000 feet long was constructed to the large wheel at the pumping station. This conduit before reaching the pump well passed thru a screen chamber thru which the old two wooden conduits also passed. At the intake and outlet of each conduit was placed a sluice valve so that any conduit could be cut off or either part of a conduit. Each of the turbine pumps feeds from a small and separate well connected with the main well with a gate-valve cut-off. By this method any foot valve could be inspected and repaired if necessary without interfering with the water supply of the other pumps.

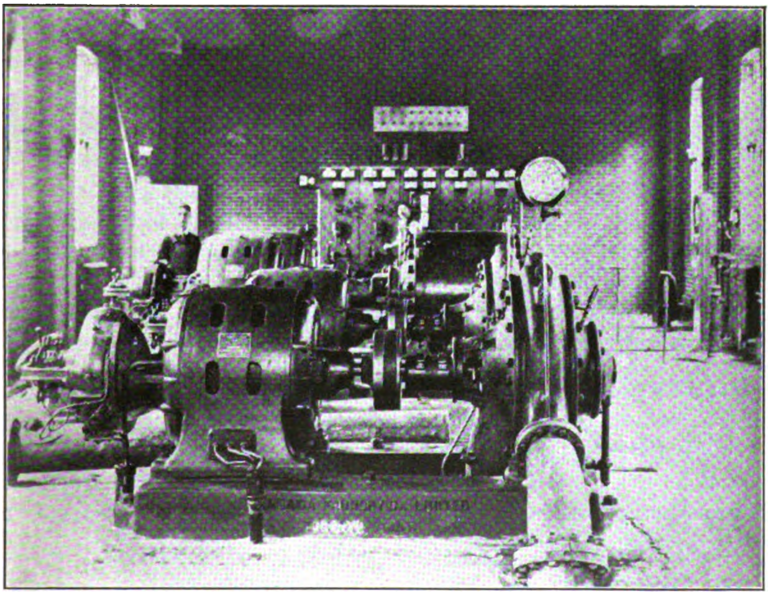
In the construction or reconstruction of any waterworks system the pumping plant is of paramount importance. What power used, steam, gas or electric, will depend principally upon the cost of these motive agencies delivered on the shaft.

Other considerations will be the capital cost of installation including size of relative buildings and cost of operation with depreciation.

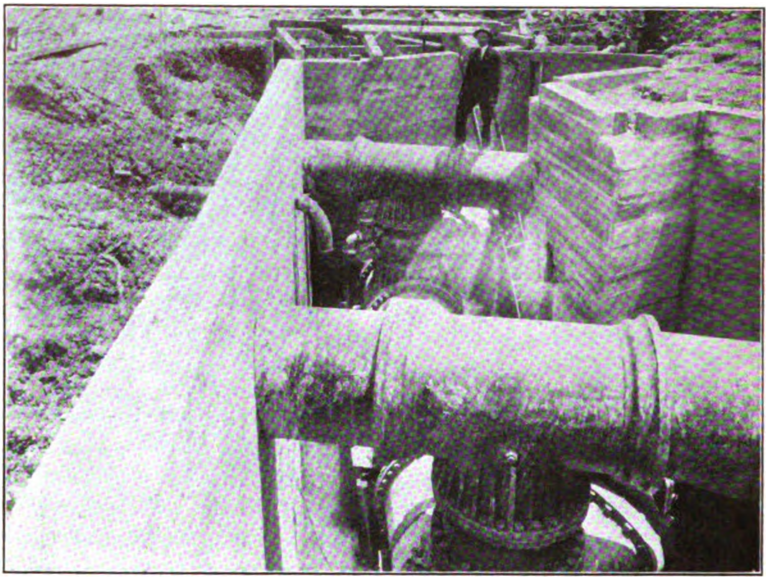
It should also be borne in mind that if the electric power be brought from a distance that it will be subject to interruptions and is consequently less reliable than the other agencies mentioned.

In Hamilton, on account of the low cost of electric power ($16.50) per annum, it was decided to increase the number of electric driven pumps to meet the future demands and the pumping station for the units already installed was enlarged. Two new electric-driven turbine pumps were installed, each of six and half million gallons (Imperial) per 24 hours, or of the same capacity as two units already in operation. There is a steam plant also having a capacity of 13½ million gallons per 24 hours which is generally held in reserve to carry the peak load during periods of heavy consumption.

The subject of plunger pumps has been well covered in several text books, but the development of the centrifugal into its present efficiency is less known. This applies not only to the design and construction but also to its operation and it is only comparatively recently that it has been efficiently applied to pumping problems.



The high-level pumping station, showing four pumping units raising water to two levels.



The 48-inch header and two 30-inch intersecting rising mains with controlling valves at the beach pumping station.

Almost any machine shop or foundry could build a centrifugal pump that would deliver more or less water against a certain head, but little attention was given to efficiency, accessibility or operation, everything being sacrificed to low first cost. Most pumping station centrifugal pumps are driven by electric motors and consequently the operating cost is a definite and known quantity and it then becomes a question of getting the maximum efficiency from the pump under the existing conditions.

A centrifugal or turbine pump has certain fixed characteristics. For instance, in a turbine pump operating at constant speed, as it will if driven by synchronous motors, the amount of water pumped increases with the drop of pressure in contra-distinction from the piston pump which always pumps the same quantity of water no matter what the pressure.

If then a turbine pump is designed to deliver a quantity of water thru a pipe or a piping system of certain diameters and length at its maximum efficiency and another turbine of exactly the same

characteristics is started to pump thru the same piping system, the frictional head from the delivery piping will increase due to the increased quantity of water and consequent increased velocity of water thru it with the result that the increased head will reduce the individual deliveries, so that the total deliveries from the pumps is equal to twice the delivery of the individual pump at the increased head, instead of twice that of the original pump if pumping by itself. If these two pumps are to work together most of the time, the efficiency curve for each pump should be at its maximum over the variations in head between one and two pumps working.

If two turbine pumps deliver into piping system that decreases the individual delivery of each pump by more than 10% it will have the tendency to cause the delivery to swing from one pump to the other so that one pump will be delivering water and the other practically churning. This may be remedied by increasing the sizes of the impellers.

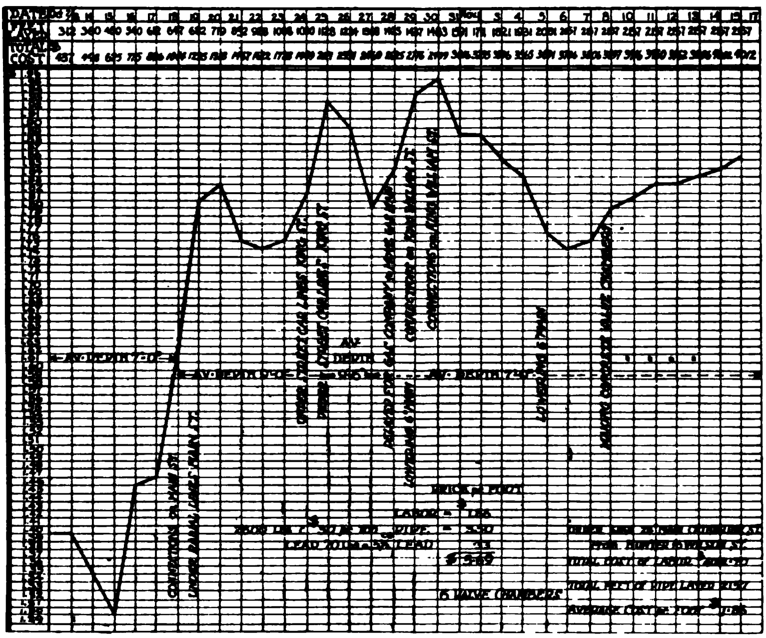


Diagram showing fluctuation in cost of water pipe laying, taken from daily report of actual cost of work.

Barton low-level reservoir of the Hamilton water works.

It is usual to keep the suction tubes of all pumps under twenty-five feet and most pumps have their suctions at not greater than twenty feet to minimize the possibility of air leakage.

It has been found in a number of cases with turbine pumps that the tips of the impellers wear very rapidly when the suction tube is greater than twelve feet. Less than this height there is little or no wear and the reason for this is probably due to imperfections in design of the turbine pump as built today altho some manufacturers guarantee over 80 per cent efficiency.

The two-stage turbine pumps that the city of Hamilton installed at its main pumping station, pump to a head of 285 feet with an efficiency of 75 per cent under full load. The tenders for two 6½ million gallons (Imperial) turbine pumps in place varied from $5,500 to $9,800. Extra impellers capable of lifting the water to 300 feet were included and the pumps had to be successfully operated for two weeks before acceptance.

Besides the main pumping station there was built a booster station to replace steam and air lift pumps and to carry the water to greater elevations than possible with the main pumping station without causing excessive pressures in the lower portion of the city. This station contains four turbine pumps each of one million imperial gallons per 24 hours. Two of these pumps raised the water about 80 feet above the level of the reservoir to which the main station pumps delivered the water and two pumps raised the water 280 feet above this level. Two-stage pumps only were necessary for the lower level below the mountain plateau, but six-stage pumps were required for the higher elevation. The problem at this station was to approximately determine the heads to which the pumps would generally work so as to get the greatest efficiency out of them. The pumps were directly connected to the mains fed from the main pumping station and about 75 feet below the level of the reservoir that the main station fed.

Besides the usual annual and daily fluctuations in head, with the added effect of the draft of these pumps on the static head there was the difference in level of two reservoirs on the main system to be considered. One of these reservoirs was only used in case of emergency or while cleaning or repairing the reservoir generally used, but as it was 60 feet lower in elevation and two miles distant across the city, and nearer the pumping station, it naturally produced considerable variation, and practically made the problem of obtaining maximum efficiency with turbine pumps under all working conditions indeterminate. The pumps as built and operated give a maximum efficiency of 60 per cent, altho under certain conditions the specified efficiency of 75 per cent is obtained.

Tenders for these four pumps in place varied from $6,000 to $6,800.

The main pumps are driven by 750-h. p. motors, the lower level pumps at the booster by 50-h. p. motors and the higher level by 130-h. p. motors. All these pumps run at 750 r. p. m.

As stated before, there were in commission from the main pumping station, three rising mains, 30, 20 and 18 inches respectively, being connected to the pumps in the usual haphazard way prevalent thruout many plants in this country. It was decided to build a fourth main 36 inches in diameter and about equal to the other three mains in discharging capacity. Altho nearly two miles of this main

had to be built to bring it to the outskirts of the city along a pipe line already used by the other three mains, it was decided to take a slightly longer route away from this pipe line to avoid the danger of a bad blow out putting all the mains out of commission.

The connections from the pumps were carried to a header pipe 4 feet in diameter running at right angles and at a lower elevation than these connecting pipes.

Between each of the old pipes and the header a gate valve was placed and as the new 36-inch main went off from the end of the header the whole arrangement proved very flexible in operation. On each of the mains was the usual check and gate valve besides the venturi tube for measuring the discharge. Before laying the large main to the city and other mains thruout the the city, tests were made to ascertain the relative efficiency and speed in making poured and lead wool joints, also the relative efficiency of joints calked by pneumatic hammers or by the usual hand method.

It was found that with the pneumatic hammers, between four and five joints could be calked wtih a poured lead joint to one by using lead wool. This was due generally to the hammers becoming wedged in driving. It was also found that the compression in the calking went deeper in the poured than in the wool joint with the consequent greater density.

Several alternate joints were calked by the pneumatic hammers and by hand and this section was gradually put under pressure. It was found that every joint calked by hand commenced to leak slightly at 110 pounds pressure but that the pneumatic calked joints remained tight.

To carry the construction of these mains thru quickly and efficiently by the city forces an air compressor with pneumatic calking tools was purchased.

The city had a small steam shovel with a half-yard dipper which did the excavating and also the lifting of the pipe into the trench. A 12-ton dinky engine with cars and track was also purchased and with this equipment (which also did the back filling) as high as fifteen 36-inch pipe were laid in a day in a trench which had a variable depth, but always sufficient to give a top covering over the pipe of five and a half feet. This large main was laid to grade with blowoffs every half mile to the city and having the usual gate and relief valves.

To compare the relative speed of hand and pneumatic calking, tests were made with the results shown in the following table:

Size inches.	Class.	Depth of Lead Joint, inches.	Weight of Lead used, lbs.	Depth of Yarn. Inches.	No. of Hand Calkers.	No. of Joints per day.	No. of Machine Calkers.	No. of Joints per day.
36	C.	3½	121	1	2	4	2	12
30	C.	3	90	1	2	6	2	15

From which it will be seen that in the 36-inch pipe the machine men calked three times as many joints as the hand men and 2½ times as many in the 30-inch pipe. Thru many local conditions entering, as for instance the filling in of old wooden bridges and the building of concrete culverts which were charged to the cost of the mains to the city, no cost data are given, but a length of 2,157 feet of 24-inch mains in the city under normal conditions is given for depth from seven to nine feet with conditions causing the variation in cost of laying indicated. The average cost per foot was one dollar and eighty-six cents for this size of pipe.

The length in feet of new mains in this reconstruction comprised:

36-inch......12,900
30-inch......13,800
24-inch...... 6,000
20-inch...... 4,600
18-inch...... 2,500

and the total cost of this work including intake, conduit, pumping stations and mains was seven hundred and fifty thousand dollars.

SOOKE LAKE WATER SUPPLY, VICTORIA, B. C.

By C. H. Rust, City Engineer.

Victoria, B. C., the capital of the province of British Columbia, is situated at the south end of Vancouver Island, and has a population of about 50,000. The consumption of water in the summer is 80 Imperial gallons per head; in winter 50 Imperial gallons per head. All services are metered.

From 1872 to 1913 the city procured its water supply from Elk Lake, situated in a northeasterly direction, about five miles from the city. The writer has been informed that the first open sand filter beds constructed in North America were erected at Elk Lake.

Owing to the growth of the city, and to the capacity of Elk Lake being only about 2½ million gallons per 24 hours, the city was compelled to take steps towards procuring a more amply supply.

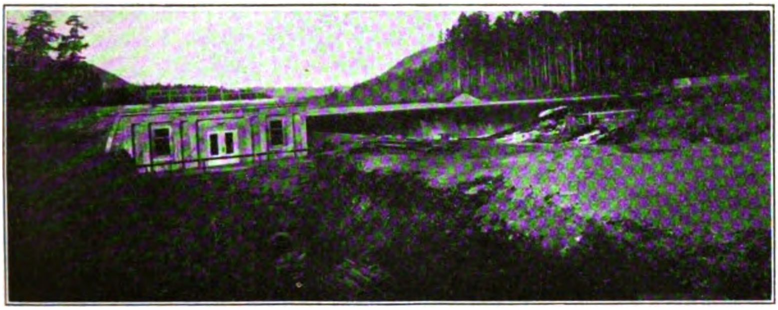
Negotiations were entered into towards purchasing the works of a private corporation known as The Esquimalt Water Works Company, who supply Victoria West and the District of Esquimalt, and who procure their water supply from the Goldstream Lakes, but the property owners voted against this proposition. These works have a maximum capacity of 13 million Imperial gallons per 24 hours, and are situated about 17 miles north of the city.

In 1911 Mr. Wynn Meredith, western representative of Messrs. Sanderson & Porter of New York, was called in by the city to advise as to the best method to be undertaken to procure an adequate supply of water. Mr. Meredith undertook a very careful investigation of various projects, and it was finally decided to utilize Sooke Lake, which lies about 18 miles northwest of Victoria.

The lake is about 4 miles in length and its maximum width is half a mile. The area of the lake at 555 ft. above sea level is 978 acres. It was decided to construct a dam at the foot of the lake and raise the level 12 ft. This gives a total area of 1,180 acres. The watershed area is 31½ square miles.

In the scheme for the ultimate development, it is proposed to utilize the Leech River Watershed, which has an area of about 31

square miles. This watershed can be used by constructing a 5-mile conduit line to convey the water to Sooke Lake, and, if it should be necessary to do this, it is proposed to construct a dam at Sooke Lake to a height of 45 ft. It is estimated this will give a daily flow of 100 second-feet whilst the reservoir storage will be 17,358,000,000 Imperial gallons. The scheme which has now been completed gives a reservoir capacity of 5,555,000,000 Imperial gallons.



Dam and Screen House at Sooke Lake.

The contract called for the clearing of the land around the lake 15 ft. above low water; the construction of a dam at the foot of the lake, with necessary screen house, intakes, etc.; the construction of 27-miles of concrete pipe 40 inches in diameter (this involved the building of 27 miles of railway track, 2 ft. gauge); the construction of 6 siphons and the necessary trestles, and temporary wooden trestles to carry the track; the construction of a telephone line; the building and clearing of a reservoir site, and the erection of a dam, screen house, valve chamber, venturi meters, etc., at Humpback, which is about 12 miles from the city; the building of 11 miles of 36-inch steel pipe, leading to the city reservoir, and was awarded to the Westholme Lumber Company of Victoria, and the following are some of their figures:

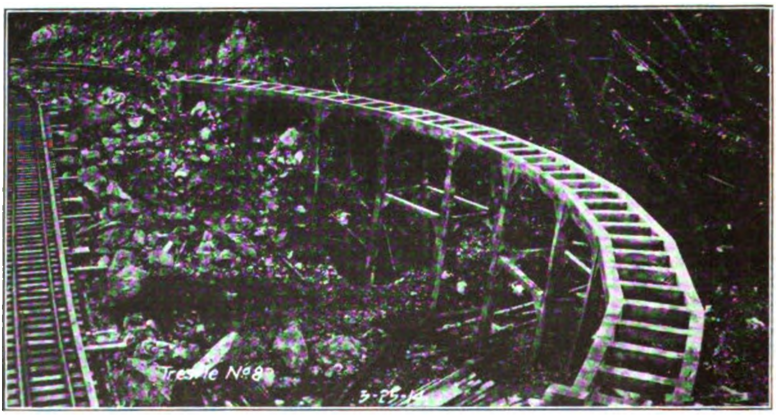
For earth excavation from 60 cents to $1.50, for rock excavation from $1.75 to $7.50, the former being the price paid on the concrete pipe-line; the price for concrete for the dam at Sooke Lake was $11.00; for the dam at Humpback the price of concrete Class "c" was $9.00, Class "b" $10.00, and Class "a" $12.50 per cubic yard. The necessary clearing around the lake ranged from $150.00 to $250.00 per acre.

Tenders were called for three classes of pipe for the flowline, namely, wood stave, riveted steel and reinforced concrete. The prices submitted were for the pipe laid and installed. Wood stave pipe was $2.47 per foot, riveted steel pipe $5.50 per foot, and reinforced concrete pipe $2.53 per foot, and it was finally decided to use concrete pipe.

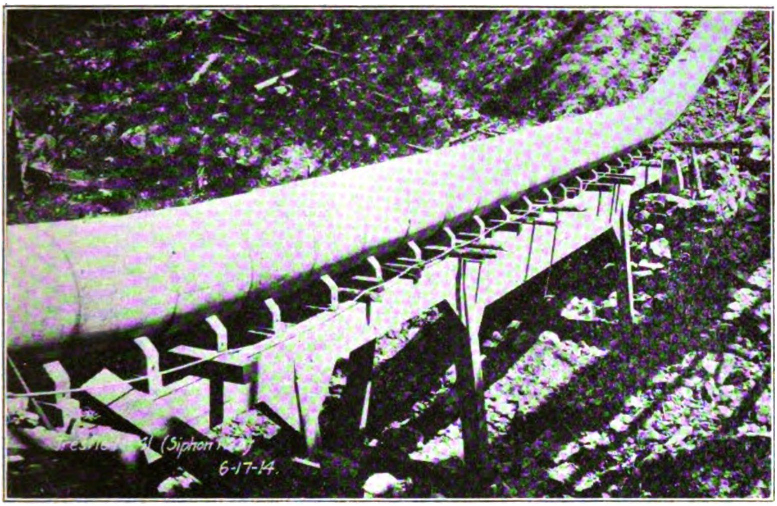
On the pressure line, tenders were called for lap-welded, riveted steel, and lock-bar pipe. The prices quoted by the contractors were as follows: Lap-welded $7.00 per foot laid and connected; riveted steel plate 5/16-inch thick $5.25, 3/8-inch thick $6.25; lock-bar pipe $6.80. It was decided to use riveted steel plates.

The contractors commenced operation early in 1912, but the progress made was not at all satisfactory, and in April, 1913, they abandoned their contract. The writer, as Water Commissioner, recommended to the Council that the work be proceeded with by day labor. This was approved of and the city immediately put on a large force of men at various camps. The laborers were paid $2.75 per day for 8 hours, one dollar a day being deducted for their maintenance. Free medical attendance was supplied by the city medical health officer.

The city completed the clearing of the land at Sooke Lake, carried out the construction of the dam, head works, etc., at the foot of the lake, and built the dam at Humpback.



Concrete Trestle to carry Conduit. Construction Railroad on the left.



Trestle No. 41 Carrying the Conduit Across Water Course at Bottom of Syphon No. 3.

It was considered advisable to call for tenders for the concrete flowline and the pressure pipe-line. The contract for the construction of the flow-line was awarded to the Pacific Lock Joint Company, and in place of a 40-inch pipe the contractors, having the necessary forms on hand, agreed to construct a 42-inch pipe for the same price, their tender being $2.29 per foot, including laying and installing but not including transportation.

The concrete pipe was made of a shell 3 inches thick and 4-ft. lengths, except the pipe used for siphons, which was more heavily reinforced and the shell was 4 inches thick.

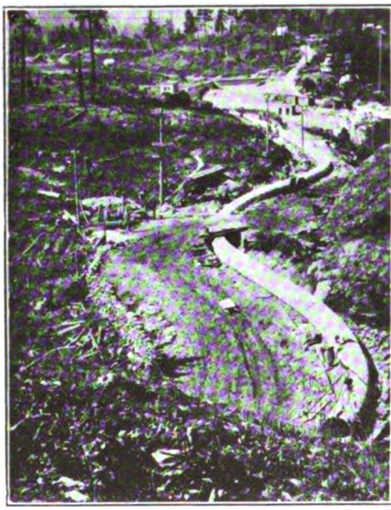
The city awarded the contract for the fabrication and laying of the riveted steel pipe to the Burrard Engineering Company, of Vancouver, for the following prices: 5/16-inch, $5.50 per foot; 3/8-inch, $6.25 per foot; but carried out by day labor the necessary excavating and backfilling.

The following is a general description of the works as constructed:

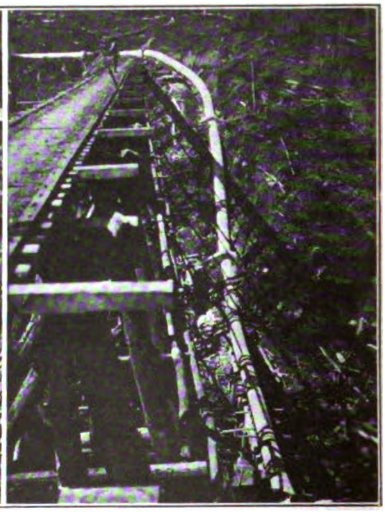
The dam at the intake channel at the lake is excavated 4 ft. below low water, where an intake tower is constructed, controlled

by seven sluice gates. The openings of these gates are protected by screen cages. From the intake tower two lines of 40-inch riveted steel pipe are laid to convey the water to the screen house. Only one of these is in service at present. In the screen house is installed a set of 12 screens. The original screens had meshes of 40 and 60 openings to the inch, but these were found to be too small, and have since been replaced by 16 and 24 openings to the inch screens. Below these screens are the measuring weir and cascade steps. The screen house is constructed of concrete with a concrete roof. The dam is a composite structure, the west end being an earth embankment with a concrete core wall bonded into the natural rock. From the screen house to the east abutment an ogee weir section 200 ft. in length is built, which is generally about 15 ft. above the level of the natural rock.

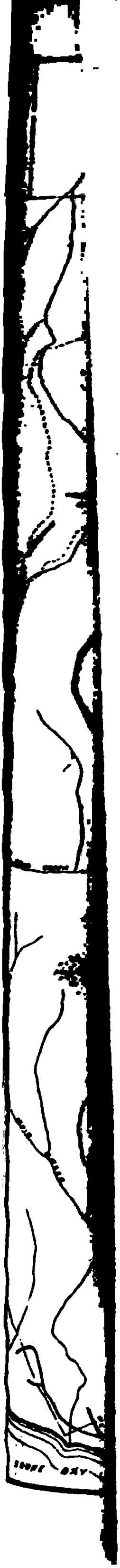
In the construction of the concrete flow-line a right of way 100 ft. wide was secured. All trees were cut down and any tall trees outside this area, which might in falling damage the pipe, were removed. The pipe is not covered except immediately in the vicinity of the Humpback reservoir, where it was thought slides



Concrete Pipe Line near Humpback Reservoir.



One of the Syphons. Temporary Trestle for Construction Railway on the left.



Concrete Pipe Line at the Humpback Reservoir.

might occur. At distances of 2,000 ft. apart on the conduit line there are open standpipes, and all inverted siphons, of which there are six, have waste outlets at the bottoms controlled by 6-inch gate valves. The deepest siphon is 600 ft. in length and has a maximum head of 90 ft. The whole of the pipe-line was constructed to a grade of one foot in a thousand feet.

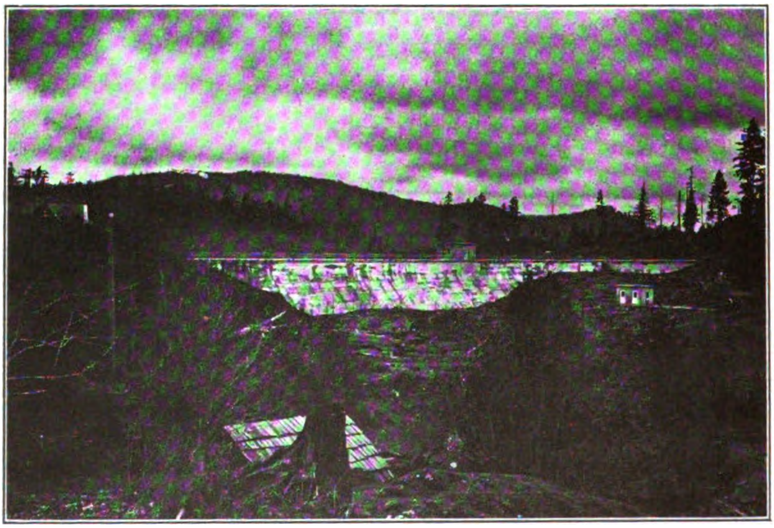
One of the difficulties in connection with this scheme was to secure a reserve reservoir at a proper elevation and in fairly close proximity to the city. A suitable site was finally located at Goldstream on the Humpback road, about 11 miles from the city. This reservoir has a storage capacity of 136 million gallons and covers an area of 33½ acres. This area was covered with a very thick forest. A portion of the reservoir site had black soil of a peaty

nature. It was decided to cover this with a 6-inch layer of clean gravel. The dam is 560 ft. long, 60 ft. in height, and contains about 9,000 cubic yards of masonry.

The water flows into the reservoir from the flow-line over a series of concrete steps. There is also constructed a by-pass 24 inches in diameter by which the water can be taken direct to the pressure line. There is in addition a submerged outlet controlled by a butterfly valve. During the past summer, owing to algae in the reservoir, the water has all been sent to the city direct thru this by-pass. Owing to the great pressure, it was decided instead of delivering the water direct to the city to permit it to overflow into Smith's Hill reservoir, situated within the city and having a capacity of about 15 million Imperial gallons, which acts as a standpipe.

It is interesting to record that during the construction of this work, the greater portion of which was of a hazardous nature, no fatal accidents occurred.

The flow-line follows the shoulder of the mountain and the work involved the clearing of a dense forest composed almost entirely of Douglas fir.



Dam at the Humpback Reservoir.

The city, so as to protect the watershed from any possible danger of pollution, has purchased the whole area comprised within it, being about 15,000 acres for the sum of $12 per acre. The city expect ultimately, if they so desire, to more than compensate themselves for this expense by disposing of the very large amount of valuable timber which is on the watershed.

The abandoning of the work by the contractors, the Westholme Lumber Company, led to a protracted litigation. The company entered suit against the city, claiming $500,000 damages. The suit was heard in Victoria last winter and the judge hearing the case was assisted by two assessors who were civil engineers. The case lasted six weeks and a verdict was given for the city, but the company appealed and no doubt the case will be prolonged for some time before a final decision is reached.

The system was completed at the end of May and put into use on the 2nd of June, 1915.

Some interesting tests were made on the concrete flow-line. The original contract called for the delivery of 16 million Imperial gallons per 24 hours thru the 40-inch pipe. As previously mentioned the contractors without an additional cost constructed a 42-inch pipe and the maximum flow from tests thru this pipe was 22,400,000 gallons in 24 hours.

One accident has occurred to the concrete pipe-line. During a forest fire a tree came down the side of the mountain and broke one pipe and cracked six more. These repairs, however, were quickly made.

The contractors for the flow-line guaranteed to maintain the pipe for a period of one year. At present there is a leakage in the 27 miles of about 500,000 gallons per 24 hours. It is expected that these leaks will be entirely eliminated when the necessary repairs are made.

The following is the actual cost of the work carried out by the city:

Sooke Lake.

	Per cu yd.
Earth excavation in construction of dam at Sooke Lake	$1.42
Rock excavation	4.24
Concrete in foundation of dam	15.68

All the cement had to be shipped by rail and hauled by teams about ten miles over very rough roads. The gravel and cement were procured from the upper end of the lake, and had to be towed to the foot of the lake. This involved the placing of a tug in the lake, which had to be transported from Victoria over the mountain, and the construction of scows.

Concrete Pipe-line.

Pipe per linear ft.	$2.32
Concrete trestles	.18
Railroad	.53
Transportation	.33

$3.36 per lin. ft.

Telephone Line.

Cost per mile $426.

Steel Pressure Line.

Contractors' prices were as follows:

5/16-inch....$5.50 per foot.
3/8 -inch.... 6.25 per foot.

The city did the earth excavation and backfilling at the following cost:

Earth excavation	$1.32 per cu. yd.
Backfilling	.55 per cu. yd.

Humpback Reservoir.

Earth excavation	$ 2.09 per cu. yd.
Rock excavation	12.78 per cu. yd.
Clearing	605.00 per acre.
Placing gravel in bottom	2.48 per cu. yd.
Concrete foundations for dam	9.00 per cu. yd.
Concrete in dam	10.05 per cu. yd.

These prices included plant, tools, equipment, supplies, bookkeeping, etc.

As previously mentioned, Mr. Wynn Meredith of the firm of Sanderson & Porter of New York, was consulting and designing engineer, and had charge of the construction. He was represented on the ground during the progress of the work by Mr. Boyd Ehle.

The following data in connection with this work may be of interest:

Area of Sooke Lake at 655-ft. elev. city datum...... 978 acres.
After 12-ft. rise, area ....1180 acres.
Land clearing around the lake .... 300 acres.
Length of concrete flow-line 42-inch in diameter.....144,040-ft.
First pipe made 20th April; commenced laying 16th May, 1914; finished on 8th May, 1915.
Length of Pressure Pipe-line 36 inches in diam. ......56,677-ft.
Started to mfg. in July 1914; finished laying Jan. 1915.
Total quantities of earth excavation ....180,342 cu. yds.
Total quantities of rock excavation ....150,517 cu. yds.
Cost of construction, including engineering, etc. ..$2,037,176.00
Cost of land, which includes right of way for pipe-lines, site for Humpback Reservoir, land adjoining Sooke Lake and the Sooke Lake drainage area..$540,000.00

REPORT OF THE COMMITTEE ON STREET PAVING.

FREDERIC A. REIMER, Chairman.

The Committee on Street Paving present for consideration and discussion the various papers noted in the program.

The careful study of the papers presented gives evidence that there is thruout the country a strong forward movement of engineers in the developing of a safe, economical and scientific plan of construction and maintenance of the country's highways.

Up to a few years ago no engineering problem had been more neglected than that of the proper development of constructing our road systems. This was especially true in its relation to a well organized plan for the maintenance of roads after they had been constructed. Public funds spent on the construction of good roads became a pernicious waste and a folly when not immediately followed by a well organized system of maintenance. Definite progress has been made in the past decade in the selection of materials for road construction so that today we have in common and accepted use known materials which have passed from the experimental into the tried and proven class of road construction. The various specifications adopted by the American Society of Municipal Improvements include all such materials.

Less progress has been made in the road maintenance problem, due primarily, we believe, to the failure of municipal authorities to recognize the absolute necessity of establishing a maitnenance department on scientific lines. We find, therefore, in many sections of the country, roads that had once been the pride of a municipality in disrepair, and in some cases almost in disuse. In this direction we call particular attention to roads built of bituminous materials. Such roads are more apt to be neglected than either broken stone roads or the more expensive block pavements. This is due to the fact that roads constructed of these materials are too often considered as not requiring the expenditures for repair for a number of years. This is a mistaken theory and the result of such neglect is more noticeable than on the other type of construction. When disintegration once attacks bituminous material it is rapid and destructive and should be jealously guarded against by careful, systematic and

energetic watchfulness. Repairs costing but a few cents when disintegration is in its initial stages will save hundreds of dollars in the long run.

We call special attention to the need of giving closer supervision to the restoration of pavements after cuts have been made in them for the installation of public utilities. This phase of repairs is more generally neglected than many others, and is probably the cause of more accidents and unpleasantness than neglect along other lines. The many ugly patches noticeable in our granite and other block pavements could be largely obviated by the proper supervision of these restorations.

There is a dangerous tendency in some localities for municipalities to expend a very large proportion of its road appropriation in the improvement of one or more of the main highways to the almost total neglect of the balance of their road system. This is to be discouraged as it is far preferable to develop a well constructed road system, we will say of broken stone roads, and then maintain a well organized patrol system, than it is to spend large sums of money to build a few miles of main highway and neglect the balance of the system.

The committee call attention to the necessity of a closer co-operation between municipalities, county and state authority, so that when road work is projected there will be taken into consideration the good to be obtained in its relation to the larger unit rather than to a particular locality. We urge, therefore, that this society co-operate to its fullest extent in the promulgation of road legislation which will bring about this end.

Respectfully submitted,

R. Keith Compton,
B. E. Briggs,
F. A. Reimer, Chairman.

JOINT FILLERS FOR GRANITE BLOCK PAVEMENTS.

By Clarence D. Pollock, M. Am. Soc. C. E.
Consulting Engineer

In laying a granite block pavement the question of the joint filler is an important factor which should be carefully considered. As in everything else, there is no one "cure-all." Under some conditions one filler seems to give the best results, and under other conditions some other filler has been more satisfactory.

The writer's idea in preparing this paper is to call attention to the merits and demerits of the various fillers, with the hope of causing more experimenting by engineers to the end of obtaining more successful fillers than we now have.

In the earlier granite pavements, the blocks were laid without a concrete foundation, simply upon a sand bed or cushion, and the joints were filled with sand. A covering of sand was left on the surface of the pavement usually for about a month, or until the blocks were firm and the joints would take no more sand.

When concrete foundations came into use a better joint filler was sought and we had the so-called tar and gravel filler. This usually consisted of coal tar pitch or a mixture of coal tar pitch and asphalt, which was heated and poured into the joints after they had been partially filled with washed gravel, then more hot gravel was added and the joints again poured until they remained full. This was fairly satisfactory until better cut blocks were used and closer joints were demanded. Then it was necessary to use finer gravel in order to get it into the joints. With the finer gravel it proved impossible to get the bituminous filler down into the joint to an effective depth. Next we had the Portland cement grout joint, and also the bituminous filler mixed with sand and poured while hot. These two forms seem to be the best at present.

If the conditions are such that the traffic can be kept off and diverted to other streets so that the cement grout may have at least a week to become thoroughly set, and the character of the street is not constantly changing and requiring many openings to be made, the cement grout makes a very satisfactory filler, when conscientiously done, but if the traffic conditions are such that it will cause

great hardship to business to absolutely block off the street for so long a period, it is necessary to use a bituminous filler. In deciding which filler to use, it should be remembered that whenever openings are made it will be necessary to block off traffic again when the trench pavement is replaced, if a Portland cement grout filler is used.

The requisites of a good filler are—that it should hold the blocks firmly in position, remain permanently in place, afford support to the edges of the blocks and thus prevent chipping and consequent rounding of the tops of the blocks. It should be easy to apply, reasonable in price, and a material which will permit of traffic directly after it has been placed in the joints of the pavement.

Portland cement grout complies with all of these requirements except the last, that of permitting traffic on the pavement soon after applying the joint filler. This is a very considerable defect on important streets in the larger cities, and in general prevents its use in such places. But wherever the conditions are such that the work can be blocked off for the proper setting of the cement, both in the first construction of the pavement and whenever trenches are repaved, a portland cement grout, conscientiously made and applied as specified in the standard specifications of this Society, will give most satisfactory results. It is necessary to pay very close attention to the details in order to insure uniformly good results. In general a machine mixed grout is much better than one mixed by hand. If the work is carried on under a hot summer sun, the surface of the pavement should be kept moist by sprinkling for at least three or four days after the grout has been poured. Sand or earth spread over the pavement and sprinkled with a hose every evening is a good method of "curing" the joints. Grout joints cannot be made satisfactorily in cold or freezing weather.

Bituminous fillers overcome the faults of a cement filler, but they have faults of their own. One that is suitable in the summer season is usually too brittle in the winter, and it breaks out under traffic. The bituminous fillers given in the Society's granite specifications, are used in combination with fine gravel. This has not proven a very efficient method of filling the joints. In using fine gravel, the bituminous filler tends to mat on top of the gravel, and does not go down into the small voids in the gravel. Traffic then picks out the filler from the top of the joint, and then the joint is but little better

than the old style sand one. Much better results have been obtained by using coal tar pitch, asphalt, or a mixture of the two, in combination with sand, the sand not to exceed 50% of the total.

Our specifications as adopted October 8, 1914, at Boston, do not specify much as to the results desired of a "gas tar pitch filler," but go into considerable detail in regard to the results which the asphalt filler must give as to being of proper consistency for both summer and winter weather, etc. The writer has obtained better results with asphalt fillers, and mixtures of asphalt and coal tar fillers than with tar alone. It seems to be practically impossible to obtain a straight gas tar filler which will not crack and be brittle in cold winter weather if it is not too soft in hot summer weather. The old mixture of one hundred parts of coal tar pitch and twenty parts of asphalt, which was used as long as twenty years ago in Brooklyn, has given much better results, in work which has come under the observation of the writer, than the straight coal tar pitch. Good results have been obtained with straight asphalt fillers also.

It is desirable that experiments be tried, using various mixtures of asphalt and coal tar pitch, and also using straight asphalts, in combination with as much sand as the bitumen will carry satisfactorily. The finer and more uniform the sand the better the results seem to be. A sand which will all pass a 10-mesh screen should be used.

There is demand for a bituminous filler that will flow into the joints readily, and stay there permanently. It should have sufficient body when cold to give a fair amount of support to the edges of the granite blocks, and protect them from the abrasion of heavy metal tire traffic. The mixture with hot sand before pouring has been a great help in improving the bituminous filler. The next step should be the determining of the proper bitumen or mixture of bitumens.

Since writing the above paper an examination has been made, at the request of the Granite Paving Block Manufacturers' Association, to determine, if possible, the cause or causes of small defects which sometimes occur in cement grout filled granite block pavements.

The examination showed that in places where the pavement generally was first class, there was occasionally a small spot where one or

two blocks would be broken or cracked. Often the cracks had the appearance of laminations. Sometimes more blocks would be broken, but usually there was only a small pot hole, as it might be called. This was found to be the case with every kind of granite which has been used around New York City and vicinity, whether it was comparatively soft, medium or hard granite. These spots occurred at points where the grouting appeared to be in perfect condition for a considerable distance in all directions about them.

Shows Pea Gravel too High in Places.

The fracture of the blocks seemed to indicate that the cause was due to pressure from expansion. Where the grout was poor and broken out, there were no broken blocks. Upon removing blocks at these pot holes by beginning several blocks away from the broken ones, the grout was found to be good and had penetrated well down in the joints, but when the joint immediately adjacent to the broken block was reached, the grout proved to be good for only one inch down from the top of the block, and was either poor or else simply pea stone below this. In every case the break followed very closely the bottom line of the good portion of the grout. In other words the top of the block had crushed and the bottom portion, where the grout was poor or missing entirely, remained intact. The blocks which had cracks across them like laminations proved to be whole and sound except for the top portion above the bottom line of the

good grout. This all thoroly backed up the theory that the cause of the fracture was the pressure being concentrated upon the small area of the good grout. In fact one sample was removed from about the center of an actual bulge in the pavement, which had lifted from the sand cushion sufficiently to be noticeable and to give forth a hollow sound when struck with a sledge. The fracture of the block was very recent and probably occurred during the extremely hot spell in September. The block was removed towards the close of that hot period.

As mentioned above, where all the grout was poor, no broken blocks were found. On the other hand where all of the grout was good and filled the joints from top to practically the bottom of the blocks, such as in Worcester, Mass., upon Main Street, where a comparatively soft granite was used, not a single break has developed during the fourteen years since this pavement was laid.

This careful examination in many localities shows that these small defects in grouted granite block pavements are due not to hard or soft stone, but result from poor workmanship. The grout should be either uniformly poor or it should be uniformly good, and preferably the latter. There should be no half way about it. An even mixture should be used and the grout should penetrate the joints uniformly to a depth no where less than three inches. With such a depth of good grout, no blocks were found to have failed by crushing, not even where comparatively soft granite was used. Wherever possible the grout should be mixed by machines and care should be taken to secure a uniform product, like thin cream. The grout should be delivered into the joints directly from the machine by a spout or hose, so that the sand will not separate out, as it is very likely to do with transportation in wheelbarrows, and the like. Attention to these details results in a good flawless pavement.

DISCUSSION.

MR. STERN: Mr. Pollock seems to advise against the use of even a small quantity of gravel in the joints.

MR. POLLOCK: I think it is advisable to go as far as leaving it out entirely, thus making the work more "fool proof." If no gravel is allowed on the street it will not get into the joints.

Mr. Stern: We tried leaving out the gravel in the joints, but the results were not as satisfactory as when a small quantity of gravel, about an inch in depth, was used to pin the blocks. Without the gravel the blocks did not ram so well, and they rocked under the feet of the workmen walking on them, with the result that the surface was not so smooth as where the gravel was used. Of course, there must be careful supervision to see that too much gravel is not used, but this is no argument against its use, for supervision must be constant and highly intelligent and conscientious thruout the entire period of laying the pavement from the very beginning to the end to insure good results.

As regards the joint filler, I fully agree with Mr. Pollock that wherever possible portland cement grout is by far the best. Owing, however, to the traffic conditions in all our large cities, and also to the fact that there are so many unavoidable cuts made in the pavements, it would be a very great hardship to close off streets long enough to make good repairs with cement grout. The quicker a repair can be made and the street thrown open to traffic, the better, even if the results are not always the best.

Mr. Blair: I desire to say on the question of filler, first as to the manner or method of mixing: We often see a failure of the cement filler due largely to the fact that it is not properly mixed. It must be gradually mixed, first to a mortar, and then add water gradually. If you pour water in, or apply with a hose, or put in the maximum amount at once, you are going to wash off the cement from the sand, and you will have a mixture without adhesive qualities. We have failure again by reason of the fact that the stone or brick, on becoming warm or dry, application is made without wetting and cooling the sides and edges. You cannot have a proper adhesion of the cement filler when the bricks are hot, dry or dusty.

There is one other question that the gentleman raised with reference to New York City which I want in all seriousness to submit to the consideration of the engineers of this country. The cement filler, the last speaker has conceded, is an ideal filler. It means two things: first, an absolutely sanitary condition. That is needed in New York, and it is needed in every city. It means another thing which I think is not fully appreciated in this country, and that is the durability of the pavement itself. I think the time that is neces-

sary, the inconvenience resulting to the traffic, is fully compensated by the worth of the pavement after it is built.

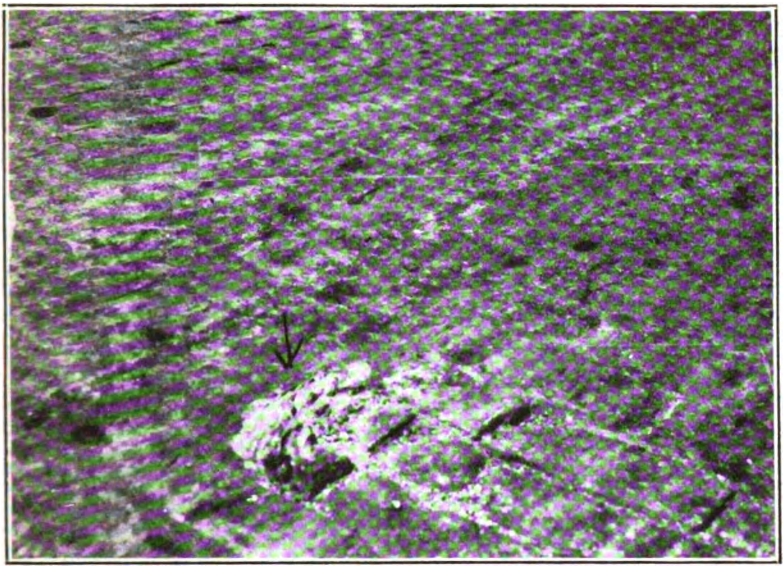
Now, I want to cite an instance, and that is a stone pavement around the southwest corner of the Square in Cleveland, Ohio, which was properly built and properly cemented in 1901. It has been in constant use ever since, and it has grown better from that day until now. It has been cut into a number of times, and it has been successfully and perfectly patched. Just a few days ago, a cut thru the entire distance of that pavement was made, and a gentleman whom I will not name, an engineer, a member of this Society, and a man who I believe to be a very close observer, passed over that, and I told him that it had been cut into from beginning to end about three weeks ago, and he said, "I couldn't find it at all." Now, I believe that in New York City or in Chicago or anywhere else, the seven or eight days sacrifice to the traffic is worth while in the economy of the pavement itself, because that kind of a pavement built right is good in any of our cities, no matter where or how great the traffic.

PRESIDENT HOWELL: I would like to ask Mr. Blair whether that is a granite block paving.

MR. BLAIR: No, sir. It is a Medina stone pavement. Granite pavement constructed in like manner shows much greater lasting qualities, provided the granite is of good quality.

MR. POLLOCK: I have seen that Medina pavement which Mr. Blair speaks of, but I am not the one to whom he referred, because I did see where the cuts were made, altho I had to look very closely to find the patches. The work was very well done, indeed. The patches were slightly rougher than the surrounding pavement, but I think within a few months' time, with the traffic on it, you would find it practically impossible to pick out the location of the cuts.

In regard to Mr. Stern's statement as to going back to putting gravel in the joints, that was always our theory, to use sufficient gravel to pin the blocks for ramming, but the trouble is, in my experience, it is hard to get such inspection that you can always keep that gravel down sufficiently. The contractors have a tendency often to put too much gravel in and to economize on the filler. I think if



Shows the Result of Getting Pea Gravel too High in Joints at a Small Spot, When Cement Grout is Used as a Filler.

an examination is made of the results, such as the extra maintenance, on granite pavements where gravel has been used with a filler of cement grout, engineers would omit the gravel. I have laid granite pavements using no pea stone or pea gravel in the joints, and I found that there was enough of the sand cushion which would come up and make a little ridge between the courses of block to hold the block sufficiently so that they will stay in place and not tilt before the filler is applied. I would rather have not quite as good a surface on the pavement to start with, and be sure that my joints are filled, than to have too much gravel in some joints.

Mr. Howard: At intervals since 1883 I have observed in Berlin, Germany, that close-joint, smooth granite block pavements on solid foundations are used on some streets which have very light traffic, where slight noise is not objectionable. The granite blocks are cut about eight inches square, and set lozenge-fashion; the rows crossing the street at an angle of 45 degrees to the curb. The object is to suppress maintenance cost which is in the end the cheapest pavement when other factors and needs are not to be considered. The

U. S. used to build wooden docks for our ships, costing perhaps a few hundred thousand dollars, and then spend many thousands annually, say 20% of the cost, in maintaining them. Now we build great concrete or granite docks, costing millions, but very little, not 2% annually, to repair them; by far the cheapest in the end. Economy in maintenance and not cheap first cost is true economy for city and government improvements.

Mr. Stern: It might be interesting to know that on Third Avenue, where we omitted the gravel in the joints, we found the surface was rougher than in the adjoining block where gravel was used. As to inspection, a good inspector can very readily prevent the joint being filled up with gravel. The entire work of paving is done under careful inspection, concrete, sub-base, ramming, surfacing, the blocks themselves; and getting the right amount of gravel in the joint is simply one more item to be looked after. I do not believe you will get quite as smooth a surface when omitting the gravel. That is my experience.

Mr. Durham: I was interested in Mr. Pollock's conclusion in regard to methods of filling the joints in granite block pavement, and the desirability of the omission of gravel as a filler, because all my experience has led to the same conclusion.

As a result of three years' work in the Boro of Manhattan, during which time nearly 25% of the street area was repaved under his direction, including some twenty-five miles of granite block streets of the modern type, the speaker found that the best results were obtained by having the blocks laid in close contact so as to be self-supporting without the necessity for filling joints with gravel in order to bind the blocks or to "pin them together," as the common expression is. As a matter of fact, any gravel, coarse or fine in joints, has a tendency to pin the blocks apart, for as soon as this practice is specified, the contractor will become less careful in regard to laying the blocks close, which again will require more gravel, and the inevitable result of such procedure is that we get to traveling in an ever widening circle or spiral, using alternate arguments which are necessary to support each other, but each of which leads to the old type of wide-joint pavement. As Mr. Stern has said, careful inspection can avoid that. Experience with municipal work will teach him that one has to employ the type of inspector furnished, and one that cannot be allowed any latitude of judgment.

By employing accurately dressed blocks which can be laid with the closest joints, and careful culling on the work to see that none are permitted to be used that tend to make wide joints, it is the speaker's belief, based on knowledge, that there can be obtained a much better granite block pavement and one which will last longer than by the use of any gravel as a filler. Careful inspection of those streets in New York City which have been laid both ways, and have had two or three years' wear, shows the difference very clearly.

In reference to Col. Howard's remarks about Berlin and its practice as to the closing of streets, it may be said that he has raised a very good point, and one which should be taken into consideration whenever possible, namely, the constructing of a new street surface one-half width at a time so as to permit of some use during construction. That this can be done has been shown in many cases in New York City in past years. It is necessary, however, to correct his positive assertion, because there is in the speaker's possession a photograph of a Berlin street entirely closed to traffic during the operation of repaving which was proceeding in a somewhat leisurely fashion. Whatever may have been the law, the fact was that the street was closed as well as others observed at the same time, in 1913.

It may be said in passing that Berlin is not noted for particularly good stone pavements, and that the best of this type on the continent of Europe are found in the city of Hamburg. Here they are laid frequently without even a bituminous filler, and appear to be eminently satisfactory. The blocks are accurately dressed with joints in many cases as small as ¼″ in width.

The speaker is convinced that this question of joint width is the most important in attaining a successful, smooth granite block pavement as contrasted with the old wide-jointed type where the heads of the blocks wore round after a short period of service.

By giving closest attention to a specification requirement calling for ⅜″ joints, the blocks to have accurately dressed heads, and to be laid in close contact, it is possible to lay the most successful type of granite block pavement, employing a mixture of tar or asphalt and sand as a filler, without any gravel. The practical result of using the gravel, aside from the question of widening the joints, will be that none of the bituminous filler will penetrate to any considerable depth, as has been illustrated in every case that has come to the speaker's attention, and particularly in those streets where

the specifications have been recently modified in the Boro of Manhattan.

PRESIDENT HOWELL: I would like to ask Mr. Durham if he had any trouble in getting the 3/8" joint with hard granites from eastern Massachusetts or the South.

MR. DURHAM: With reference to that question, sir, I would say that I had trouble at the start in obtaining blocks I wanted from all the granite cutters. They were not turning out as careful work three years ago as they are today. As a practical answer to the question, I can point to some streets in the Boro of Manhattan which have today granite block pavements two and three years old, laid in part with blocks from various New England quarries and in part from two Southern quarries, one of which furnishes a very hard granite, so-called, that is, one having a very high resistance to compression. All were laid under the 3/8" joint specification, and altho we did not attain this minimum in every case, we certainly averaged it.

PRESIDENT HOWELL: We have had a little experience with that in Newark, and came to the conclusion that it could not be done with certain kinds of granite.

MR. DURHAM: There are two streets in downtown New York which were paved in 1914 with Eastern Massachusetts granite where I think it may safely be said we attained the 3/8" joint thruout; certainly in no case did the joints exceed 1/2". The resulting pavements were remarkably good and are today as good as there are in the city, and they will compare very favorably with any street in this country or in Europe. There is also a main thorofare in their vicinity paved for over a mile of its length with granite blocks from several of the Maine quarries, giving equally satisfactory results. Sample blocks from all of these streets when tested, gave high resistance under compression, and average results in testing for abrasion and impact. All these streets were laid with the blocks in close contact and the joints filled with a mixture of tar and sand, but without using any gravel or small stone.

MR. POLLOCK: As far as getting the close joints, they can be gotten with all the granites that are suitable for paving block, it is simply a question of some granites requiring a little more labor than others.

NAPPED OR RECUT GRANITE PAVING, AS USED AND CONSTRUCTED IN BALTIMORE.

By R. M. Cooksey, Principal Assistant Engineer of Paving Commission, Baltimore, Md.

Until 1913, the old granite blocks which were replaced in this city by smooth material were retained by the city for use of the Repair Division. This course could be easily followed so long as the city was only replacing a small quantity of the old granite paving each year, but, when the repaving of the entire city was undertaken, this disposition of the old material was out of the question, as it would have been entirely too expensive to store such quantities of old block, the amount being used for repairs each year being so small, the storage would soon have amounted to considerably more than the value of the material. Upon reviewing the amount of old granite block streets that were to be replaced with smooth pavements, it became necessary to find some use for the old blocks, so the question of redressing was taken up.

The first work undertaken along this line was the re-heading and re-jointing of the old blocks. This did not prove satisfactory, for, in re-heading, it was often necessary to cut as much as 2 inches off the depth in order to save the thickness, in a case of badly rounded blocks, resulting in the block being made too shallow. This method also made the cutting expensive, as, in order to secure a well dressed head, it was necessary to use a pointing tool, making the work of the cutter slow, and, of course, the price of the cutting higher.

The old blocks which are used for this work vary in size as follows: 8″ to 14″ long, 4″ to 6″ wide and 6″ to 8″ deep, and all of the above varying sizes are often cut and used on the same piece of recut paving. The specifications for redressing the blocks is as follows:

> "The contractor will assort, clean, split, reel and redress the blocks so as to have rectangular faces, free from bumps, with straight edges on the tops, ends and sides, so as to form, when laid close, joints not exceeding ¾ of an inch in width. The blocks are not to be over six (6) inches in depth."

As we nap practically all of the blocks, with the exception of a few which are used as starters in order to break the joints, the average block laid on recut work in this city is about 6″ long, some of them running as short as 4″, and will average about forty-two to the square yard. In using the napped block throughout, we find that we obtain a surface equally as good as we have ever gotten by using a new granite block, and at a cost of about two-thirds of that of new granite.

There still exist in this city about 700,000 sq. yds. of old granite pavement on sand foundation, so that this city will no doubt continue to replace this pavement with a more suitable material, and recut the blocks so secured, placing them in heavier traffic sections.

During the year of 1913, 6,296 sq. yds. of recut granite, with bituminous filler, and 2,945 sq. yds. of recut granite, with cement filler, were laid, making a total of 9,241 sq. yds. During the year of 1914, 3,991 sq. yds. of recut granite, with bituminous filler, and 20,393 sq. yds. of recut granite, with cement filler, were laid, making a total of 24,384 sq. yds. During the year of 1915, 20,805 sq. yds. of recut granite, with bituminous filler, were laid, making a total of 57,930 sq. yds., and a grand total laid to date of 91,535 sq. yds., at a cost of $215,587.73, all of the above being laid on a sand cushion.

The prices ranged on this class of work, in the city area, for cement filler, including 6″ concrete base, etc., from $2.05 to $3.00 per sq. yd. The latter price of $3.00 was an exceptionally high one, and was for just a small amount of work. For the same class of work in the railway area, the prices ranged from $1.85 to $2.66 per sq. yd. In this case, the price of $1.85 was exceptionally low, and was bid on a very small amount of paving. For the city area for bituminous filler, 6″ concrete base, prices ranged from $2.38 to $2.70, and in the railway area for the above, from $2.10 to $2.78. Taking the entire area paved with napped or recut granite blocks, the average cost per square yard to the city for city area was $2.36, and for railway area, $2.24, for cement filler, and for city area, $2.45, and for railway area, $2.48, for bituminous filler. All of the above includes 6″ concrete base, the city furnishing the old blocks, and the contractor cutting, napping, re-jointing, paving, grouting and furnishing sand cushion.

Quite a large yardage of this pavement has been laid, using a bituminous filler, and, though it gives a very good pavement, it does not compare favorably with cement filled work. As the blocks are of such various depths, ranging from 4″ to 6″, we find it difficult to maintain a good surface where the bituminous filler is used. In future work of this class, we propose to use a cement mortar bed in place of the sand cushion, and the writer believes that this will be a decided improvement, for the cement filled as well as the bituminous filled work.

In connection with the recutting of the old block, there are, of course, a great many block taken from the streets which are too small to recut. These block are culled and are used on a concrete foundation, with cement filler, for alley paving in the heavy traffic districts. This takes care of a great deal of the waste from the old original paving, and it furnishes a cheap, heavy construction for alleys and narrow streets. Where a street is being paved, carrying with it a railway area, in order to take care of the shallow blocks which are cut, the concrete base is raised within this area and the shallow block are culled out by the pavers when they are paving the city area. These are immediately placed in the railway area, and in this manner a uniform cushion is obtained under the blocks. This method, of course, is hard to pursue, except in the case of a railway track street.

ASPHALT REPAIR FOR SMALL MUNICIPALITIES.

By W. H. Taylor, Jr., City Engineer, Norfolk, Va.

Just as certainly as pavements of asphaltic composition are laid, the subject of repairs soon becomes a real and not an imaginary event. In growing communities repairs caused by street openings for various underground services, are often necessary in advance of repairs from deterioration, however carefully such services are provided for in advance of laying the pavement.

The mystery so long surrounding the construction of asphalt pavements having been dissipated and the simplicity of repairs demonstrated, it is in my opinion the part of wisdom for municipalities, especially small ones, to construct asphalt plants in proportion to their repair needs, thereby establishing independence of the contracting world in performing ordinary maintenance work. The amount of repair work, in municipalities with small asphalt yardage, beginning with the first few holes of trifling dimensions, does not increase rapidly enough to justify costly outlays for repair equipment, during a period extending over years. The paving contractor cannot be interested in repair work until the amount assumes profitable proportions. The subject in its "infancy" and until it reaches its "teens" undoubtedly can be handled with an inexpensive apparatus susceptible of easy manipulation and of producing new surface material or renovating old asphaltic mixtures. With simplified equipment, the "personal equation" or skill of the plant foreman including familiarity with the products handled increases in importance and demands careful consideration. Recognizing that each municipality has its own peculiar problem or unique situation to deal with, a general law for asphalt repair work can hardly be framed. The work and necessity of rectifying a few small patches, one extreme, differs materially from the restoration or reconstruction of an entire street surface, the other extreme. The former problem or question involving "Repairs and Repair Plant for Small Municipalities" the subject of this paper, is one upon which much time and money can yet be profitably spent.

Undecided after having investigated many plants manufactured for the purpose I am still investigating the subject with a plant

homemade and with apologies intend giving an answer to the question at issue by briefly describing our efforts and the accompanying results.

The city of Norfolk, Va., situated near the entrance of Chesapeake Bay, in Latitude 36 degrees 51 minutes N., Longitude 76 degrees 17 minutes W., has 80 miles of paved street, 43.7 miles of which are of sheet asphalt or bitulithic construction, totaling 668,320 square yards. The streets of the city are on an average elevated 8 to 10 feet above mean sea level. Drainage and sub-soil conditions are unfavorable, occasioning unusual maintenance outlays.

As the scope of this paper will not permit of a discussion of our best and poorest efforts in constructing sheet asphalt, of contributory causes and errors revealed by time, leading to some early failures and numerous repairs, permit me to state that we have endeavored, when permitted, to follow closely expert advice and standard specifications, and have constructed streets that have endured reasonably heavy traffic for fifteen years without repairs, and we have a few streets, repairs to which have aggregated to date over 50 per cent. of the original area. An analysis and subdivision of our streets into classes, according to various specifications, reveals the following relative durability and percentage of repairs. The age of the streets in the various classes being about the same and traffic conditions not dissimilar:

Class 1—Asphalt on concrete base—Streets without car tracks—Yardage 189,200. Total repairs to date 2.6%.

Class 2—Asphalt on concrete base—Streets with car tracks—Yardage 147,000—Total repairs to date 29%.

Class 3—Asphalt laid on old cobble stone base—Streets without car tracks—Yardage 14,236—Total repairs to date 39%.

Class 4—Sheet asphalt laid without binder, on concrete base—Streets without car tracks—Yardage 21,044—Total repairs to date 25%.

The question of repairs and of satisfactory equipment for making repairs became one of considerable moment and importance to the city of Norfolk within a very short time following the expiration of the guarantee period of the first large construction contract. Briefly stated, the methods pursued which have resulted in our present

system, departing from the ordinary only in that we have used extensively for small repair work old surface mixture, vast quantities of which I have seen discarded and used for filling, have been as follows:

In 1908 the Barber Asphalt Paving Company having completed a contract in Norfolk involving both new work and extensive repairs, just before dismantling the plant furnished the city 266 tons of sheet asphalt surface mixture. This was stored in layers separated by boards and cut in cubes before cooling. With painstaking care and unlimited patience, the Department of Public Works of Norfolk made its first asphalt repairs by reheating the previously prepared mixture in a fire wagon built for the purpose. However for very limited work only would I advocate or advise such a procedure.

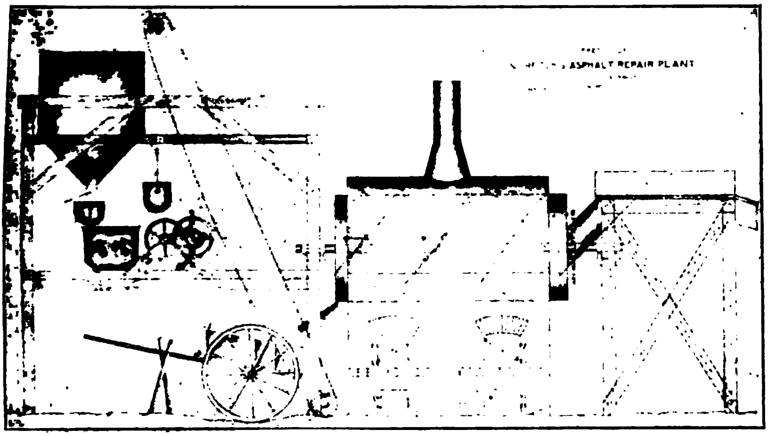
With the above exception, from 1906 to 1912 repairs in Norfolk were made by contract, the price varying from $2.00 to $1.40 per square yard exclusive of base. Our repairs at the present time average about 1,000 square yards per month, to be exact, 23,500 square yards the past 2 years, and are made by city pavers working usually one week each month. This rate maintained annually amounts to 2¼% of the yardage of all pavements in the city five years old and over. Whether more or less in amount than it has been Norfolk's misfortune to cope with, everywhere repairs are inevitable and in view of the extravagant and exacting demands of the traveling public, I repeat, preparations for repairs should, in my opinion, soon follow original construction.

Frequently, in years past, while waiting for a contractor's plant to become available, we have had small holes spread from curb to curb, increasing in size with unbelieving rapidity, occasioning just complaints which we were powerless to correct.

Independence of the paving contractor for repairs, established by constructing a very small plant, has enabled us to keep Norfolk's streets in far more satisfactory condition and to reduce the cost of such work from the previous low price of $1.40 per square yard, average of $1.75 per square yard, to 60 cents per square yard. We have made many thousands of yards of repairs at 50 cents per square yard using old material. The average cost above stated of 60 cents for the past two fiscal years, embracing the use of both old and new

materials, includes all regular repair charges and 33% each year of the original total plant cost—itemized as follows:

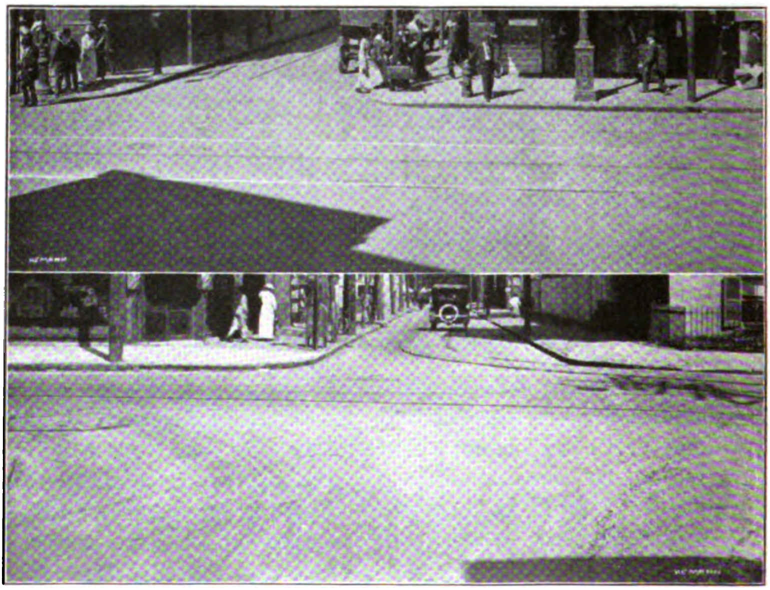
Materials	$ .05
Labor at Plant	.15
Labor on Street, including haul..	.30
Plant and Tools	.06
Fuel and Current	.02
Miscellaneous	.02
	$ .60



I submit herewith a free-hand sketch or diagram of the equipment with which we have accomplished the above mentioned results.

It was created or constructed of much discarded material and a few minor purchases, the result of authorized experiments, looking to the use of a large amount of sheet asphalt pavement taken up and removed for the construction of a street railway, and collected on a vacant lot. From an abandoned crematory steel smoke stack 4 feet in diameter) two ten-foot sections were cut. Of one section a drum or cylinder was made, and a shaft was run thru the center and supported on journal boxes, enabling the drum to be readily revolved. The usual spider and loading chute were constructed at one end and a discharge opening next to the outside of the circle was cut in the other end. The drum was mounted above a brick fire-box or furnace, in length about 18 inches shorter than the drum.

Above the brick work a portion of the stack, section No. 2, was used to enclose the furnace over and around the drum. A 5-h. p. motor furnished power thru reduction gears and chain drive, to revolve the drum at the rate of 12 revolutions per minute. The loading chute terminates in an elevated platform from which an incline leads to the ground. The inside of the drum has fixed to its sides spiral vanes so arranged that they propel the material as the drum revolves towards the unloading end. It has several proportionately larger movable vanes or doors, so arranged that the material is propelled in a direction opposite to that set up by the fixed vanes, or when willed, in the same direction. When set to work against the fixed vanes, the movable doors, one of which terminates at the unloading opening, prevent the material from coming out of the drum, and keep it well and evenly distributed thruout its length. When otherwise set the material is rapidly propelled towards



Intersection Main and Bank Streets—Business District.
Resurfaced with old material August, 1913.

Intersection Boush and Bute Streets—Semi-business District.
Resurfaced with old material July. 1913.

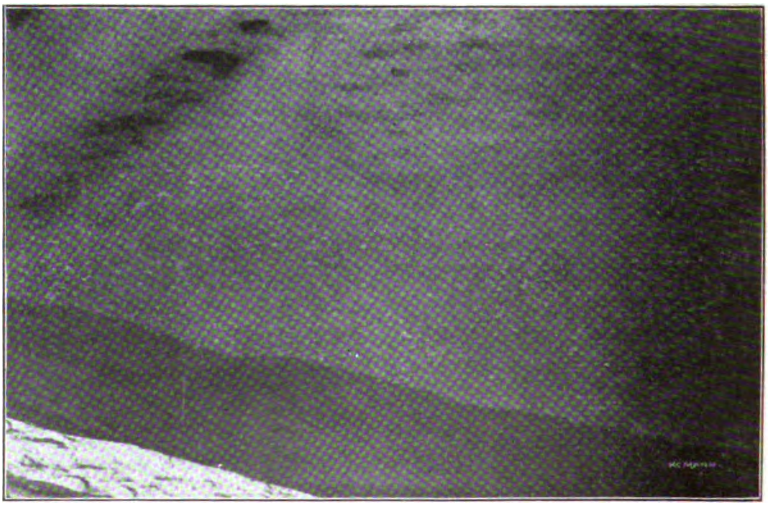
Intersection Westover Ave. and Thetford St.—Residential Section. Resurfaced with old material, 1914.

the unloading end and thru the discharge opening into a waiting cart. The movable doors are connected by rods and maintained in parallel position. They are operated by a small handle, attached to the door, protruding thru the discharge opening and are held in the desired position by simple spring catches. The change of doors from one position to the other is made when the doors are at the top of the revolution, being then free of material. This improvised apparatus erected for experimental work has served for nearly three years, making over and serviceable for use a large amount of old material.

It has also produced a considerable quantity of new binder and surface mixture. For the latter purpose, however, we have lately added a standard 9-cubic-foot asphalt pug mixer, a sand bin and chain elevator with which we produce with more certainty new sheet asphalt surface mixture or binder, the drum, of course, being used to heat the sand or stone.

You will note the dual nature of the plant, its adaptability for making over old material or producing new standard mixtures as desired.

Before attempting to use the old material we determine by analysis the sand grading, particularly with reference to the 100- and 200-mesh material, also the amount of asphaltic cement that it contains, a desirable tho not absolutely necessary procedure, for if the amount of A. C. is unknown a simple substitute of the pat paper stain with a little experience will fairly well determine an excess or deficiency of asphalt. Adding from 1 to 2% of new asphalt (120 penetration Dow machine) to take the place of that lost during its previous existence on the street, and that which suffers injury in the reheating process, and occasionally a small amount of portland cement, we have produced mixtures which, carefully watched for over two years, still evidence life and durability. Many chemical analyses before and after indicate live bitumen in amount corresponding to that contained in the old mixture plus that added. The average of a large batch of old material used during 1913-14 showed a bitumen content of 9½%.



Near view of the intersection of Main and Bank Streets, resurfaced with old material, 1913, showing ¾-inch binder stone, an unusually large percentage of which exists in the mixture, revealed by traffic.

Upon the addition of 2% by weight of new asphaltic cement and reheating, the same material analyzed 11% bitumen, the complete analysis being as follows:

Bitumen	11.06%
Passing No. 200 sieve	11.01%
Passing No. 100 and 80 sieves	23.62%
Passing No. 50 and 40 sieves	32.84%
Passing No. 30 and 20 sieves	19.34%
Residue on No. 10 sieve	2.13%
	100.00%

There is undeniably a certain volatilization of the lighter oils of the asphalt as evidenced by a slightly hardened mixture. The presence of steam, generated from the moisture nearly always contained in the old material piled in an open lot, has, in my opinion, a tendency to prevent burning or "coking" and leads to better results than otherwise would be obtained.

The old material broken in lumps from 4 to 5 inches in size, binder adhering, is wheeled up the incline, loaded into the drum and allowed to remain from 12 to 15 minutes. Investigation has revealed the fact that the old mixture disintegrates in the drum, not by gradual peeling off of thin outer layers of each lump, but by sudden dissolution or breaking down of the whole mass, in from 5 to 7 minutes. A wood fire maintained as uniformly as possible heats the mixture in the length of time mentioned to 300 degrees. It has proven possible to regulate the temperature to within a few degrees of the desired heat by timing, each batch being carefully timed in and out of the drum and temperature recorded.

With the original apparatus we made 11,000 square yards of repairs during 1913-14 entirely of old material at the rate of 150 to 200 square yards per working day, and have recorded but few failures.

A similar device will, in my opinion, serve for the initial "Asphalt Repairs for Small Municipalities." It will make serviceable for use old surface mixture. It will produce new surface mixture and binder in limited quantities. Time and experience will dictate when the addition of the pug mixer will prove advantageous. For ordinary repair work for small municipalities it has with us proven its practical value and efficiency.

A normal day's run for the plant is exhibited in the following summary taken from the reports of the plant foreman and paving foreman respectively, September 30, 1915, the work being the removing, reheating and relaying of a portion of Granby Street, one of our principal thorofares.

Plant Foreman's Report:

9 loads (18 boxes, 7 cu. ft.) New binder
24 loads top

Street Foreman's Report:

Laid 225 sq. yds. 1½" top
Laid 115 sq. yds. 1 " binder

Material and time for day's work as follows:

Binder Material, per square yard	$0.105
Top Material (A. C.) per square yard	.015
Fuel, per square yard	.033
Plant and Tools	.050
Labor and Haul	.204
	.407

Several intersections and other short stretches of streets have been taken up, reheated and relaid for test purposes both with and without binder, photographs of which I submit herewith, giving the location and year relaid. To date neither cracks nor other unfavorable signs have developed. The renovated pavement softens under the summer sun and shows slightly the markings of traffic. It has behaved in such a manner as to inspire confidence in its endurance.

Of the 480,230 square yards of sheet asphalt in Norfolk 20% of it with an average life of 14 years must soon be resurfaced, having deteriorated to a point where further repairs are impracticable. The present surface must be removed, reheated with the addition of sufficient A. C. and if required, dust, to convert it into an acceptable sheet asphalt surface mixture and then relaid, or the entire street surface hauled away to be used in part only for repairs. The problem is one fraught with many uncertainties and difficulties. I am not ready to admit that a practical solution is not to be found in the re-use of the old surface, and to this end intend shortly the

building of a larger, more substantial and better mechanically designed plant, along the lines of our first efforts, with a capacity of from 60 to 80 square yards of 2-inch surface per hour.

The question is, can a material sufficiently uniform, stable and durable be produced, justifying the expenditure of 40 cents per square yard, which I estimate will be the total cost when handled in large quantities?

TYPES OF BITUMINOUS CONSTRUCTION.

By Francis P. Smith, Ph. B., M. A. S. C. E., M. A. I. C. E.,
New York.

The selection of the most economical and suitable types of bituminous road construction to meet a given set of traffic, climatic, subsoil and drainage conditions, involves a clear comprehension of the limitations of the various types in use and the conditions essential to their successful employment. Certain conditions should absolutely preclude the use of certain kinds of construction regardless of possible low first cost, and disregard or lack of knowledge of the vital principles underlying different forms of construction has often resulted in the waste of large sums of public and private money.

Whatever type of construction is decided upon, it must always be borne in mind that a bituminous wearing surface is flexible and will only give good service when it is properly supported by an adequate foundation. Soft spots or weak places in the foundation will cause a settlement of the overlying wearing surface which will result in rapid deterioration. Water will collect in such low spots and rapidly destroy the bond between the bituminous binder and the mineral aggregate. The wheels of each vehicle passing over such depressions will strike a heavy blow as they drop into them and cause displacement of the wearing surface, resulting in the formation of a ridge which still further adds to the vibration of the springs and causes successive blows to be dealt to the pavement until the spring vibration becomes normal again. This, of course, results in the formation of waves. In most heavy commercial vehicles the springs are comparatively short and stiff. The vibrations are, therefore, quick and tend to strike very heavy blows, resulting in wave formation at right angles to the line of traffic having their crests from 3 to 4 feet apart. This is plainly noticeable on roads having a bituminous wearing surface and it is still more evident on water-bound macadam roads. The poorer and less rigid the foundation the more pronounced the waves. This is quite distinct from the shearing or shoving action exerted by vehicles rounding curves at a moderately high rate of speed. The motor bus is perhaps more directly responsible for this type of wave formation than any other

modern type of vehicle. In England, more especially in the neighborhood of London and other large cities, it is easy to pick out those roads which carry motor-bus traffic, as they invariably show the kind of wave formation above described. On water-bound macadam roads it is no uncommon thing to find considerable stretches in which the difference in level between the wave crests and troughs amounts to 4 inches and over. This wave formation is noticeable in rock and sheet asphalt pavements laid on 9 inches of concrete as well as on country roads covered wtih sheet asphalt, tarred slag, bituminous concrete or bituminous macadam. Generally speaking, the wave formation in sheet or rock asphalt pavements laid on concrete foundations, while noticeable, is not excessive, whereas in bituminous surfaces on inferior macadam foundations it is one of the primary causes of disintegration. The consistency of the bituminous binder used in these English roads is on the average somewhat harder than that used in the United States and there are no long hot periods to soften them up such as are frequent here. In their very moist climate it has been found that a harder bitumen adheres more tenaciously to the mineral aggregate and is less affected by water action. It is fair to assume, therefore, that their road surfaces are at least no more plastic than ours and personal examination showed that in the majority of them the bonding qualities of the bitumen had not been weakened by water action and that the grading of the mineral aggregate was normal. The writer believes that much of this could be avoided by having longer and more flexible springs on vehicles of this type, thus greatly lessening the road shock.

Slow moving, heavily loaded vehicles are much more prone to cause displacement and wave formation than are the lighter type of vehicles moving at a speed of from 15 to 25 miles per hour. This was clearly shown by a 60-ft. street in one of our eastern cities which was paved with a bituminous concrete mixture containing more stone than the average Topeka mixture. The foundation was 5 inches of concrete and the average grade about 3%. A trolley line in the center of the street sharply divided the moving traffic. The traffic uphill was composed largely of slow-moving, loaded, 3- to 4-ton horse-drawn vehicles and a few motor trucks, whereas on the down grade it was confined to light delivery wagons and empty trucks, but the number of vehicles on each side was about equal. The pavement on the uphill side very soon developed wave formation to such an extent as to require a large amount of resur-

facing, whereas that on the down-hill side gave satisfactory service for a long period wtih practically no wave formation. Both sides were laid with the same mixture and at the same time. The concrete in many places was defective and at these points the wave formation was most marked.

In the writer's opinion wherever the traffic calls for a bituminous surface, a concrete foundation is justified and is economically sound. There is always movement in a mcadam foundation, as evidenced by the rounded edges of the stone of which it is composed. This is noticeable wherever a macadam road is dug up or scarified. If the larger particles of stone are screened out from the mass and examined, their edges will be found to have become rounded by attrition. Where the traffic is very light, as on country roads which are not main arteries from or between large cities, and in some residential streets, old macadam roads have proved to be suitable foundations for bituminous surface mixtures. Far more failures than successes have resulted from their use, however, and great caution should be observed with respect to employing them. Many roads are classified as macadam roads which contain no base course of large stone and are in reality old dirt roads on which comparatively fine stone has been dumped and consolidated by traffic, no provision having been made for their proper drainage. Unless constructed on a sandy soil such roads inevitably become quagmires in spring when the frost comes out of ahe ground and are totally unfit for use as a foundation. New York State has many miles of penetration roads constructed on such foundations which have utterly failed, sometimes within six months after they were laid. Before using any macadam road as a foundation its history should be investigated and more particularly its behavior in the spring of the year. The character and depth of the stone should be determined by putting down a sufficient number of test holes and proper under- and side-drainage must be provided. In most instances it will be found necessary to rebuild the road in many places. Assuming it to have been a properly constructed and drained macadam road and hence suitable for a light traffic foundation, (and the number of these is very few), it will be necessary to re-grade it and probably to reduce its crown before placing any bituminous surface upon it. In a few cases this can be done by filling up the depressions and building up the shoulders. Wherever possible this method should be employed, as traffic will compact a road far better than is possible with a roller, and a

road surface which has been scarified and then rolled will never be as hard and firm as if it had been compacted by years of traffic. Where new stone is added in depressions or on the shoulders, the road bed on which it is laid should be clean and slightly loosened to insure proper binding of the new stone. The size of the added stone should be the same as that which would be employed in building up the corresponding portions of a new water-bound macadam road and should be thoroly rolled with a road roller weighing not less than 10 tons until it is well compacted and vehicles passing over it do not cause displacement. Water and screenings should be used during rolling to effect this. Unless this work is thoroly and conscientiously done, the foundation will not be of uniform strength thruout and settlements will probably occur at those places where the new stone has been put in.

If it is necessary to scarify the road surface, this should be done with care not to go deeper than necessary and the surface of the road should be built up with new material and rolled until the greatest possible compaction is obtained, exactly as if building a new water-bound macadam road. If it is then possible to turn traffic upon it for a few months before laying the bituminous surface, so much the better, as any weak spots will be developed and still greater compaction will be secured. To do all this thoroly and as it ought to be done (including drainage) will often cost almost as much as putting down 5 inches of concrete. With the concrete a permanent and satisfactory foundation is assured, which may be re-surfaced when necessary at the minimum expense. In England a number of fairly heavy traffic roads have been successfully surfaced with sheet asphalt or bituminous concrete using the old macadam as a foundation, but as a rule their macadam roads have been in existence for a long time and have been properly constructed and, owing to their moist climate, have been thoroly drained. They, therefore, start with a much better foundation on the average than we can hope to obtain. Their winters are mild and frost rarely penetrates to any considerable depth into the earth, hence they are free from heaving and the unstable conditions produced by our spring thaws.

Where the sub-soil, drainage and climatic conditions are especially favorable, a foundation of 4 to 6 inches of broken stone properly consolidated by rolling may be used for light traffic roads. Except under extremely favorable conditions, the proper construction and drainage

of a base of this kind will cost more than would 4 to 5 inches of concrete.

The question of foundation having been settled, the kind of wearing surface must next be determined. The various types of bituminous construction under consideration may be classified as follows:

Coarse aggregates,
- Penetration method,
- Cold mixture,
- Hot mixture.

Fine aggregates,
- Topeka,
- Sheet asphalt.

As between coarse and fine aggregates, the heavier the traffic (more especially that carried on iron tires), the finer should the mineral aggregate be. Large particles of stone will be fractured sooner or later by the passage of heavy loads over them. Wherever such a fracture occurs we have two faces which are not cemented together by bituminous cement. This permits grinding away and the entrance of water, two extremely destructive agencies. As illustrative of this, in certain sheet asphalt pavements laid by the writer in heavily travelled sections of Glasgow, Scotland, it was found to be necessary to exclude grains of sand coarser than those passing a 20-mesh sieve, as even 10-mesh grains would crack and permit the water to enter and destroy the pavement. In a test made this winter in the presence of the writer of a bituminous road surface at the National Physical Laboratory at Teddington, England, in which a road continually flooded with water was tested to destruction by the passage of heavily loaded iron tired wheels over it, it was found that disintegration commenced at those points where large sized grains occurred on the surface. Large sized aggregates give a rougher road surface, and hence better foothold for horses than do smaller sized aggregates, and automobiles are less liable to skid upon them in wet weather. For light and moderate traffic there is, therefore, much to be said in favor of large sized aggregates. As between penetration methods and mixing methods, the latter are undoubtedly far superior. In the case of portland cement concrete, except in special forms of construction, grouting is seldom resorted to except where mixing is impossible and in this case we have a fluid cement which readily penetrates the interstices without chilling or becom-

ing solid for a very considerable period of time. When grouting broken stone wtih a hot bituminous cement its tendency is to chill as soon as it strikes the colder stone. Its distribution is, therefore, very uneven and whenever the interstices are small practically no penetration takes place. Work of this character should never be done except in the hottest weather and yet we see many of these roads constructed in the late fall. It is really the most difficult kind of bituminous work to execute properly and yet because of the cheapness of the plant required, many contracts are let to small contractors who have never done such work before. A few years ago suitable portable mixing machinery was not available for work of this kind except in the vicinity of railroads and hence some type of bituminous construction had to be developed which was cheap and could be put down without the use of heavy and non-portable plants. These conditions no longer exist and the writer believes that for this and other reasons the penetration method of construction will gradually disappear. When, because of failure or increase in traffic, it becomes necessary to reconstruct a penetration road laid on a broken stone foundation, practically all of the road must be removed and this is an expensive piece of work. This is not true of a bituminous road laid on a concrete foundation. The foundation can still be utilized and in most cases resurfacing is all that is necessary.

As between hot and cold mixtures the hot mixtures can be better graded and more thoroly compressed by rolling and are, therefore, somewhat better suited for fairly heavy traffic. For light traffic the cold mixture will in many instances give equally good results and will often be very much cheaper and will, therefore, always have a wide field of usefulness. Cold mixtures would appear to be ideal for use by road patrols in the upkeep of bituminous road surfaces constructed of large aggregates and are much superior to hasty mixtures of stone and bituminous binder often imperfectly made on the spot with inadequate appliances by more or less inexperienced workmen.

The so-called Topeka mixture is intermediate between the sheet asphalt and the coarse aggregate mixtures. As ordinarily made, it consists of a standard sheet asphalt mixture to which has been added from 15 to 25% of stone passing a ¼-inch screen and retained on a 10-mesh screen and 10% or less of stone passing a ½-inch screen and retained on a ¼-inch screen. When well made and laid,

however, its surface is practically no rougher than sheet asphalt. Owing to the somewhat lower percentage of bitumen which it contains and the fact that it is usually laid without a binder course, it is somewhat cheaper than sheet asphalt. It is, however, a more difficult pavement to lay satisfactorily. Theoretically the coarse stone particles which it contains should make it a more stable pavement and one less liable to shoving and wave formation. As a matter of fact, however, a slight excess of bitumen renders it much more unstable than even an inferior sheet asphalt pavement and liable to extreme displacement under traffic. This is probably due to the fact that it does not contain sufficient stone to permit the larger particles to be closely keyed together. When the mixture becomes plastic thru heat these large particles are therefore relatively free to move, the only restraint to such movement coming from the relatively fine sheet asphalt mixture in which they are embedded. Owing to their size a pressure tending to displace them acts with a greater total force than it would exert on, for example, a sand grain 1/10 of an inch in diameter, in addition to which many cases there is a distinct leverage action. Too little bitumen will make a Topeka mixture open and water absorbent and a variation of ½ of 1% of bitumen above or below its proper content is about the limit of safety. Double this variation in a sheet asphalt pavement will not seriously affect it. For medium and light traffic the writer believes that a not too dense sheet asphalt mixture laid the same thickness and under the same conditions as the Topeka will give at least as satisfactory service and will be much safer to lay in the long run. The Topeka mixture appears to him to be a hybrid possessing vices and weaknesses peculiarly its own and not as good as either of the types which it is intended in part to supplant.

For heavily travelled city streets sheet asphalt on concrete foundation is undoubtedly the best type of bituminous pavement. When sheet asphalt is laid on very light traffic streets a somewhat coarser sand should be used than for heavy traffic streets. As the number of particles decreases the surface area to be covered with bitumen also decreases. In this way without increasing the percentage of bitumen in the mixture a thicker coating of bitumen is obtained on each grain of sand and the pavement will not crack as readily under minimum traffic as will a standard heavy traffic mixture. All sheet asphalt pavements are improved and their life prolonged by the passage over them of sufficient traffic to exercise a constant kneading

action and equalize the internal stresses set up by contraction and expansion.

A comparative table showing the average composition of the various bituminous surface mixtures discussed herein is given below:

	Coarse Aggregate		Fine Aggregate		
	Bituminous Concrete		Topeka	Sheet Asphalt	
	Hot Mixture	Cold Mixture		Light Traffic	Heavy Traffic
	per cent	per cent	per cent	per cent	per cent
Bitumen	7.0	6.5	8.5	10.5	11.0
Passing 200 mesh	5.0	4.5	8.5	10.5	14.0
Passing 100 mesh	4.0	1.5	6.0	10.0	14.0
Passing 80 mesh	2.0	1.5	6.0	10.0	13.0
Passing 50 mesh	5.0	1.5	6.0	14.0	19.0
Passing 40 mesh	4.0	1.5	10.0	14.0	11.0
Passing 30 mesh	4.0	1.5	10.0	13.0	10.0
Passing 20 mesh	3.0	3.0	9.0	10.0	5.0
Passing 10 mesh	5.0	5.5	6.0	8.0	3.0
Passing 8 mesh	3.0	5.0	6.0	...	...
Passing 4 mesh	7.0	8.0	14.0	...	...
Passing 2 mesh	20.0	40.0	10.0	...	...
Passing ¾″ mesh	14.0	11.0	...	...	...
Passing 1″ mesh	12.0	9.0	...	...	...
Passing 1½″ mesh	5.0	...	...	...	...
	100.0	100.0	100.0	100.0	100.0

Summarizing the foregoing brief discussion of the various principles and considerations involved in the different types of bituminous construction, we have the following:

Foundation.

Old Macadam: suitable for light traffic under favorable climatic and drainage conditions *but only when properly constructed and drained.* Thickness and character of stone layer and method of construction should be determined by test holes before adopting it. Road must be carefully shaped and graded, preferably by the building up process before laying any bituminous top upon it. Inferior to concrete.

Broken Stone: suitable for light traffic but only under favorable climatic and drainage conditions. Inferior to well constructed macadam and to concrete.

Concrete: 4 to 6 inches thick, depending upon traffic and character of sub-soil. This is much the best type of foundation and is the least expensive to resurface.

COARSE AGGREGATE.

Penetration Method: suitable for light traffic only; gives a rough surface; best results can not be obtained except with skilled labor. Should only be carried on in hot weather and stone should be at a uniform temperature not below 60° F. when binder is applied. No plant required, melting kettles being all that is necessary. Extreme care needed to prevent rich spots and bleeding. Stone must be carefully spread and fine material rigidly excluded from lower course, otherwise penetration of bituminous binder will not be satisfactory and uniform. Bituminous binder must not be overheated and must be at proper temperature and uniformly applied.

Cold Mixtures: Suitable for light traffic only; gives a rough surface. Stone must be clean and carefully graded. Bituminous cement must be of proper consistency, otherwise mixture will not be workable. Should not be laid at a lower temperature than 40° F. Work should preferably be done in warm weather. Can be manufactured at the quarry from which the rock is obtained and shipped ready to lay to the work. Rolling should be continued until maximum possible compression is obtained. Especially suitable for repair work done by patrol gangs on coarse aggregate surfaces.

Hot Mixtures: Suitable for light and medium traffic only; gives a rough surface. Stone must be clean and carefully graded to secure best results. Can be laid at any time of year. Heating and mixing plant must be within hauling distance of the work. Rolling should be continued until maximum possible compression is obtained.

FINE AGGREGATES.

Topeka Mixture: Suitable for light and medium traffic. Gives a comparatively smooth surface. Heating and mixing plant must be within hauling distance of the work. Great care must be exercised to keep bitumen contents within proper limits. Stone and

sand should be weighed separately into mixer to secure uniform mixture. Can be laid at any time of year. Rolling should be continued until maximum compression possible is obtained. Unless very carefully manufactured is more liable to shoving and displacement under traffic than is sheet asphalt.

Sheet Asphalt: Suitable for light, medium and heavy traffic but should not be laid on as steep grades as are permissible with coarse aggregates. Gives a smooth surface and can be laid at any time of year. Heating and mixing plant must be within hauling distance of the work. Rolling should be continued until maximum compression possible is obtained.

DISCUSSION.

MR. WHITE, of Chicago: This is a very excellent paper. There is one point to which I would like to call attention which has not been mentioned particularly in the description of the effect of traffic on bituminous pavements. Heavy traffic, such as trucks, wagons and teams of all kinds, unquestionably produces the wavy formation described. In my observation in the city of Chicago, where we have on certain streets a restricted boulevard traffic, in which a very large majority of all vehicles are automobiles traveling at speeds varying from 15 to 25 miles per hour this traffic on different kinds of bituminous pavements, as well as sheet asphalt pavements, has developed, not a wavy formation, but a parallel rutting which has appeared on the surface. This has occasioned the re-surfacing of many thousands of yards which otherwise undoubtedly would have been excellent pavement. This is not only true of comparatively new pavements, but has occurred on two or three boulevards where there have been sheet asphalt pavements in use for at least ten years and which had been considered most excellent examples of such pavements. The first time it came to my notice was three or four years ago, and it has appeared in increasing ratio each summer since. These old sheet asphalt pavements, which had stood and carried the traffic for ten years or more, developed the trouble just the same as the newly laid pavements. I have not had the opportunity of observing this in other cities, and I am told there is no other place in the country where it has developed to anything like the same extent. I do not think there is anything very peculiar in the climatic conditions in Chicago to account for it, and there cer-

tainly could not be anything peculiar in the character of the pavement or foundation, because it has appeared on both macadam concrete foundations. It is a phenomenon which seems to belong to that kind of traffic, and as Mr. Smith did not mention it, I thought it worth while to call it to your attention.

In re-surfacing some of these defective pavements an effort has been made to produce a very hard surface; that is, the penetration, (I am speaking of the asphalt pavements particularly now), has been kept down quite low, but on the re-surfaced work the same trouble has developed, and in some cases it has developed very quickly.

MR. HOWARD: In the Southwest they use a very rounded sand. I would ask if you have examined that sand to observe whether it is sharp angled sand, or rounded.

MR. WHITE: I would say that I have not examined the sand. The point that I meant to bring out a moment ago was that the trouble developed in the pavements which had had ten years' use, as well as those newly laid.

MR. MACALLUM: Referring to what Mr. White has said, I noticed the same thing on Commonwealth Avenue in Boston last year, almost in front of the Somerset Hotel and further down. About four years ago, some bright mind suggested the idea of doing without a binder in asphalt paving, and in a moment of weakness I accepted the suggestion, and unfortunately I tried it on two streets. Both of these streets developed the handsomest waves that I have ever seen on any streets in the country. The streets ran east and west, and peculiarly enough the waves were formed on the south side of the street almost to the center line in the second year, and about the fourth year on the other side of the street; that is, they formed continuously across. The idea at the time, I think, was to roughen the base and do away with the binder, and save about 35 cents, but as a matter of fact it was a great failure.

Mr. Smith has referred to a macadam base. In Hamilton, they laid a pavement called tar macadam. This was a failure as a pavement, mostly on account of variation in the tar. But this tar macadam base was a success as a base for an asphalt sheet pavement. Putting on an inch and a half or two-inch topping, you can't tell it

for several years from a pavement where the base is concrete. Recently we found in some streets where there is heavy motor truck traffic that the compression which is given to sheet asphalt with the ordinary asphalt roller is not sufficient. The great compression you get from the wheels of these motor trucks is much greater than the compression you get with your asphalt roller, and I have found it necessary in streets of heavy traffic to put on a road roller also.

On one street in Hamilton, called John Street, we had a six or seven per cent grade, and we used a pavement called asphalt concrete. That is what we called it in the City Hall, but the people that use the pavement call it other things. It is different from the ordinary asphalt, and being on a seven per cent grade, our own teamsters in hauling stone down there developed the faculty of going down with the rear wheels going along in the gutter at right angles and scraping the curb, but those living outside of the city did not realize the possibilities of such a pavement, and they generally came down with the wagon first and the horses after. I found that this pavement, which is supposed to have a rougher face than the sheet asphalt, developed a surface that was much smoother than an asphalt pavement; in fact, it was polished. I just want to point out the fact that on a grade of that nature, almost any kind of bituminous pavement will get to such a state that it is just as smooth as an asphalt.

MR. CORSON: I would like to ask Mr. Smith if I understood him to say that there are now no machines made for mixing which can be drawn about, or that they are obsolete and no longer in use?

MR. SMITH: No, sir: I said the reverse. In discussing penetration methods I said that a few years ago there was no portable mixing machinery of an efficient type which was available for road construction at some distance from a railroad, but at the present time that is not true. We have miniature sheet asphalt plants and miniature bitulithic plants.

MR. CORSON: For the benefit of the Convention I would like to state my experience with a bituminous macadam road using the penetration method in the following manner: After preparing the subgrade I used 4 or 5 inches of coarse aggregate, over which we put from 1 to 1½ gallon and on top of that was placed ¾-inch aggregate and that was thoroly rolled. On top of that was spread uniformly about ¾ gallon; this mixture was a patented article made in the

East; finally we topped off with screenings about the size of a pea. The coarse aggregate and ¾-inch were hard limestone. We began the pavement three or four years ago and it is giving excellent service. There has been no creeping and no wave formation and in two instances the traffic is severe.

I understood Mr. Smith to say that he lowered the crown on bituminous macadam. We insist on putting in a rather high crown and good grade. We have had excellent results. On one small street, about 7,500 yards, we purposely used a flat crown as you would for a brick pavement and that pavement has shown disintegration. Whether it is because of faulty construction of the sub-grade or because of the action of traffic, I do not know, but the streets we have built since with high crown have given excellent results.

MR. SMITH: The crown of the ordinary water-bound macadam road should be somewhat in excess of that which is necessary or advisable for a bituminous road.

A STUDY OF BRICK PAVEMENT CONSTRUCTION.

By WILL P. BLAIR, Secretary of National Paving Brick Manufacturers' Association, Cleveland, Ohio.

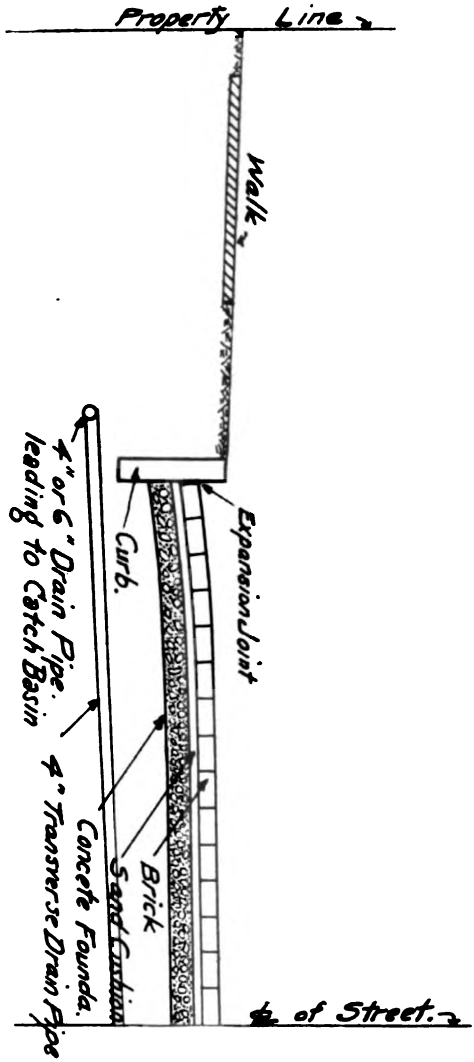
The American Society of Municipal Improvements exists for the reason that municipal improvements are not made either as to plan or construction to meet best the needs for which the improvement is undertaken. There is no other way open for progress of the Society's purpose than for each who is assigned a subject to lay before others what he believes to be for the best. Whether what is offered be accepted or not, matters not so much, if it is given fearlessly. Sometimes a very wrong or erroneous idea may of itself suggest the right. If no mistakes have been made, we have no need to be here, unless it might be to congratulate ourselves over the complete success of past efforts.

All will freely admit that the most serious trouble affecting municipal improvements, *common to all,* lies in the difficulty of getting done what should be done—*non-compliance with the directions* found in the plans and specifications, due to visible and invisible influences which the engineer has been unable to control in all places. The hindrances for betterment in this respect, though as harmfully standing in the way of securing the best in brick streets as any other class of municipal improvements, will not be dealt with in this paper. Rather, we shall look into some phases of construction that should be properly dealt with in the specifications.

Much discussion of late has been directed toward the troubles, ending in disputes and law suits, that arise out of a lack of preciseness and exactness of statement and explanation by tautologic effort which but confuses—one prominent critic saying that the accepted axiom that "there is a law suit in every contract and specification" has not been put out of use, and another states that with all that has been said and written, there are still to be found many specifications, the terms of which might be said to be veiled in mysticism.

If there is even less of truth than of fact in these statements that result in expensive law suits, how much more of bad results are to be found in the quality of work itself, regardless of the so-called over-

head vexations that are entirely due to that which is neither found in the specifications at all or due to lack of clearness and definite statement.



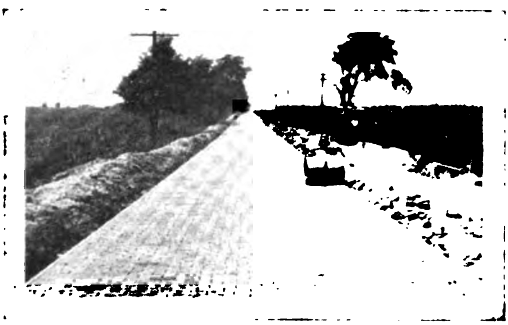
Whether the National Paving Brick Manufacturers' Association, in its general specifications, has covered what is sought to be accomplished as specifically as it should or not, we do know that in

altogether too many instances important details are disregarded and dissatisfaction results. On the other hand, we know that a full and complete compliance results in most satisfactory lasting and durable pavements. What, therefore, of extreme importance that is suggested in our general specifications or which may have been insufficiently stated or of doubtful interpretation or perchance omitted altogether, we at least know that much has failed to get into the pavement.

Section 5 of our general specifications reads: "Drainage should be provided sufficient to rapidly remove all water from the roadway to a depth of not less than eighteen (18) inches below its finished surface, and the engineer shall examine the location and provide ample plans and specifications to accomplish this result."

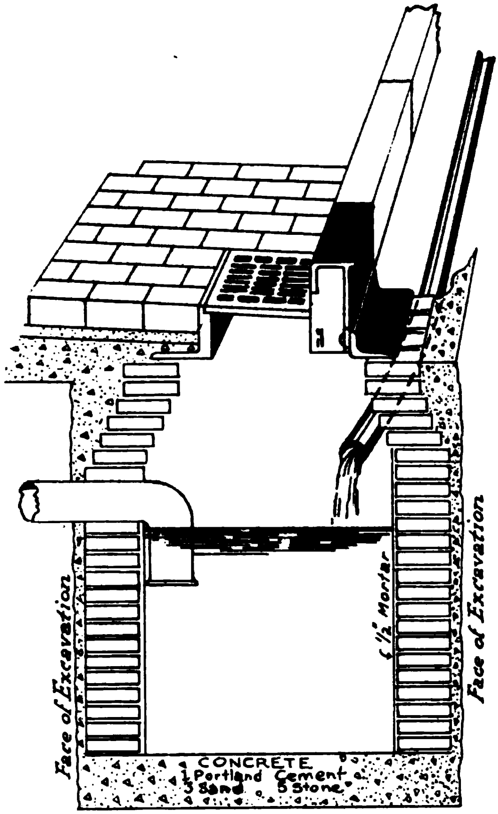
How few road beds are really ever drained at all in a way to rapidly remove all water from the roadway. Soil condition, location, the possible water supply, where, and how it must be carried to its disposition away from the road bed is given altogether too little consideration.

A system of drainage like that found in Fig. 1 will, we believe, most nearly satisfactorily accomplish the results in moist soils. The usual way of laying a tile drain underneath the curb is well nigh useless; to conduct the water through a drain tile any great distance along and underneath the roadway is worse that useless—in northern climates a great positive injury. Take the water from underneath the roadway through the drain tiles to a disposal line outside the roadway leading to the nearest catch basin; this is the method which will most nearly keep the roadway dry. Accurate information of



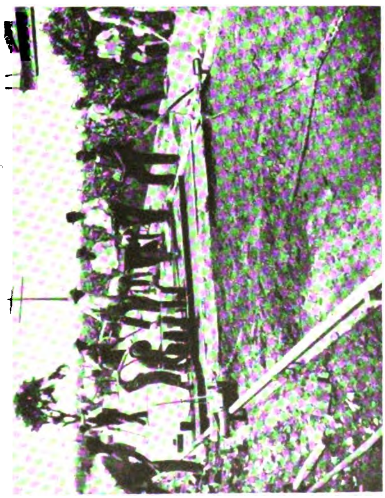
Rolling the brick surface of the morning's work, with a hand roller.

the nature and character of the soil, rainfall, etc., so that the underneath drain may be properly planned is as essential for properly designing the improvement of a street and road as for preparing the plans for a sewer system. In fact, it is far more difficult to care for water after it once gets underneath the surface than to care for it as mere surface water, and I may add that it is just as important.

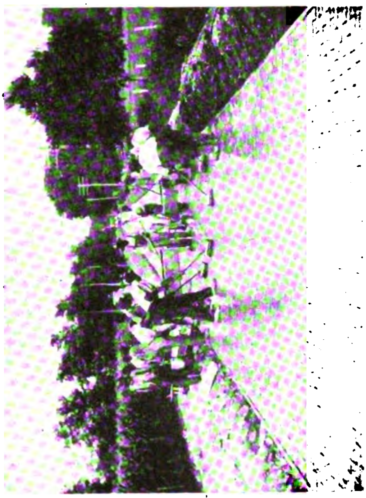


Most specifications provide for compressing the sub-grade and establishing a surface corresponding with the grade of the finished street, but few, however, provide in express terms that the grade shall so *remain* or if used in any way for travel, some provision for its protection is set forth in express terms. The consequence is that 75% of the pavements are constructed upon a sub-grade wholly out of keeping with the spirit and intention of the requirements.

If the foundation is to be of either gravel or broken stone, no adequate specification for the rolling and compression is in writing and it is, therefore, not adequately done. There has been a great improvement in making and spreading of a concrete foundation. No



Building the Middle Springfield Road out of Paris, Illinois. The concrete foundation, the mortar cushion, the laying of the brick—a simultaneous operation in road construction.



The application of the cement filler proportioned one part sand and one part Portland cement which has been mixed dry in the concrete mixer in the first instance and deposited in the boxes in small batches to which is added the water in proper quantities.

longer do we hear that you are obliged to make the foundation rough because it cannot be otherwise. A smooth foundation for a brick pavement is usually specified and obtained.

One of the things seldom accomplished is proper compression of the sand cushion. It is so difficult to get it done that many are willing to hazard sufficient resiliency for protection of the pavement by leaving it out altogether. It has but one function and only one, that is to relieve the shock due to impact in the use of the pavement and to furnish a uniform support to the overlying monolith. A requirement to fill up and roll and refill for at least three times is a necessity in order to obtain a uniform and sufficient support.

The quality of the cement filler suffers in the greatest degree, in its preparation and application. Few specifications state definitely just how this all important feature of brick pavement construction shall be executed. It is often left to the inconsiderate judgment of the foreman in charge.

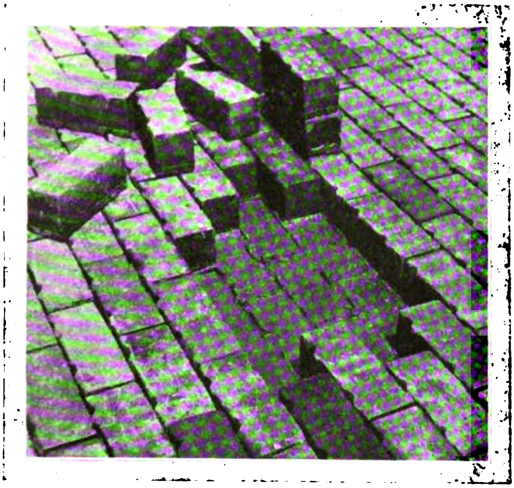
That the proportion of one to one, sand and cement shall be first mixed dry; that it is necessary that the water be applied to this mixture slowly, mixing a mortar and then diluting to the required consistency; that this mixture shall be applied so that the proportions shall be maintained in place; that the sides and edges of the brick must be thoroughly wet to secure a proper adhesion, are not given sufficient weight to influence their observance.

Other matters might be mentioned which contribute greatly to the value of the pavement but enough is here given to illustrate the meaning of the writer. There should be stated in specifications exactly and precisely what is to be done. It is assumed in these suggestions that the quality of the material used in the improvement is such that if properly used, will produce entire satisfaction in the improvement but we believe that specifications have been altogether too lax in specific requirements. We have not been so lax in the matter of providing against the use of materials of poor quality.

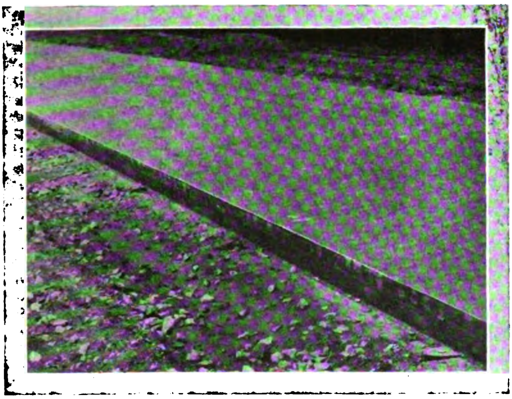
In fact, a few days ago, while making inspection with an engineer of large experience, of a street that had manifestly been badly constructed, the engineer truly remarked that "we have gone testing mad and construction wild."

James E. Howard, who has given much time to the study of thermal and traffic effects on street pavements, states that "methods of construction outweigh in importance some of the requirements of current specifications under which the brick are accepted. It is the

engineering and not the manufacturing to which attention is now most needed."



Illustrating the concrete foundation, the mortar bed, the very slight flow of mortar after the brick have been rolled, the mortar bed still being entirely wet.



Showing the face edge of the pavement after the form is taken away, against which no curbing will be provided. Only the berm and dirt roadside will be brought to grade along side, thus eliminating the expense of the curb.

We do not mean to be understood as reflecting in any way against what has been done to perfect methods of testing. We mean to suggest that engineering methods have not kept pace with the methods of testing material.

The writer has always given considerable weight to the importance of the resiliency of the sand cushion in brick and stone pavements because of its relief against the shock effect from impact. We

have, however, been greatly interested in watching the behavior of brick streets constructed in monolithic form including the foundation. Some twenty-five years ago, a street constructed in this manner in Cincinnati did not give much promise of value. A small section of brick street was laid in like manner in the downtown district of Chicago to which but little notice was given. About eighteen years ago, the brick gutters on Washington Street in Indianapolis, Indiana were so constructed. At the same time, some of the gutter on Ohio Street in Terre Haute was laid in like manner. The first two examples did not remain long in existence. The second two examples being in the gutters, scarcely afforded a condition of traffic upon which to base judgment. The most interesting example with which the writer is acquainted is a small alleyway leading to a freight yard and warehouse in the rear of Hulman & Company's wholesale establishment in Terre Haute. This construction was by laying the brick upon the green mortar bed of concrete made with seven parts of coarse aggregate, the one part of cement. The brick surface was made smooth by the use of a rammer upon a board placed upon the pavement. The joints were then filled with a one-to-one cement filler as provided in our present specifications. This pavement has been subject to frequent as well as heavy traffic for more than ten years. It is in almost perfect condition and shows no impairment whatever either from thermal, traffic, humidity or frost effect.

While it is true that hundreds of brick pavements have been built in accordance with our present specifications and which show an endurance without repair covering a period from fifteen to twenty-five years, still the difficulties spoken of and the difficulties about which we have refrained from speaking, which result in the construction of brick pavements that are not ideal leads us to question whether or not there may be a manner and method of constructing brick pavements that will insure less hazard in these respects, providing, of course, that we may be sure of equally good or possibly a better pavement.

Just now, very many brick pavements are being laid over the country, uniting the foundation and wearing surface in a single monolith. The writer has been deeply interested in the process, by which this form of pavement is laid, as developed and at present in use by Engineer W. T. Blackburn of Paris, Illinois, and a contractor of that city, Mr. Allan J. Parish. Spending an entire day with these gentlemen, observing the process used by them, we are firmly of

the opinion that in such a process, much of the hazard which endangers a compliance with specifications is eliminated. It is a process or manner and method of construction that can be clearly and definitely outlined in a specification. The implements to secure the results can be definitely stated with as much advantage, may I remark, as that enjoyed in this particular respect by the owners and promoters of patented pavements (illustrated and explained by cut or slide).

Really, one of the best things that can be said of this manner and method of construction is that you can not do it at all, unless your equipment for doing the work is complete. This disposes of make-shifts which are ruinous to pavements; it means, dropping upon the mortar cushion the brick with the best edge uppermost in the first instance. It means a careful and expert dropping of the brick. It means a systematic, steady clock-work movement in all its parts. The prepared bed must be steadily in advance of the dropper. Every step of the work must proceed in an orderly co-ordinate manner; all this means economy in construction. It means perfect work.

Mr. James E. Howard found that the resiliency of grouted brick pavements laid on a sand cushion ranged from .0003 to .0100. With such resiliency, no brick were noticed to have been broken. No brick have been broken or shattered so far as observed at present in the ten-year-old monolithic structure in Terre Haute. Just how much less resiliency may be afforded in a street, monolithic, which includes a four-inch wearing surface and a four-inch concrete base has not yet been ascertained by comparison; but we are firmly of the conclusion that enough still remains to protect against an extreme shock effect.

Upon the data obtained by Mr. Howard in his study of the thermal and traffic effects on brick pavements in the cities of Cleveland and Kansas City, he lays greatest stress upon the ability of pavements to resist thermal effects by compression. He also concludes that traffic effects on a well grouted brick pavement are but slight indeed, as compared with the thermal effects. Therefore, may we not conclude that the character of a brick pavement which is able to maintain itself by a greater compressive strength and which invites even greater relief and protection from both humidity and frost action and with all involving a greater economy in original construction that it is well worthy of most serious consideration.

Discussion of this paper will be found on page 162.

VITRIFIED BRICK CONSTRUCTION—STREETS AND ROADS.

By WM. C. PERKINS, M. AM. SOC. C. E.

Chief Engr., Dunn Wire-Cut Lug Brick Co., Conneaut, Ohio.

In these days of "good roads," the proper construction of streets and highways is receiving the attention of municipal and paving engineers. Each element of design and construction is under investigation, and efforts are being made to make the pavement more durable and at the same time to design a pavement that will be as economical as possible.

Modern traffic, especially since the advent of the automobile and motor truck, has changed the requirements of pavements. Paving engineers recognize that they can no longer follow any set of empirical rules or specifications; that highways must be designed and built to meet existing conditions as any other engineering structure is designed and built, and consequently they began to investigate the integral parts of a pavement to see if such parts or any part could not be improved so as to make the pavement more serviceable, or again, if such parts or any part could not be designed more economically.

The integral parts of a pavement are:

(1) Sub-grade
(2) Foundation
(3) Bedding course (cushion)
(4) Wearing surface.

SUB-GRADE.

In preparing the sub-grade a careful study is made of local conditions—the nature of the soil, proper drainage of the ground water, etc. If necessary, borings should be made to actually determine the condition. If the sub-grade is water-soaked, the water must be carried away and underdrains are necessary. If soft spots develop, a

sub-base course may be necessary or the spongy earth must be removed and the space filled with suitable material. Every effort should be made to remove all water from the sub-grade to a depth of not less than two feet below the finished surface, for investigation has shown that a large percentage of the longitudinal cracks in brick pavements are caused by frost heavage due to a wet sub-grade. An inspection of brick pavements in the south shows very few longitudinal cracks, and if a crack does occur in that section the trouble can generally be traced to a rigid manhole or an unstable foundation. It is, therefore, of the highest importance that the sub-grade should be free of ground water, unyielding, of uniform density and of proper grade and cross section.

Foundation Course.

The proper type of foundation depends largely on local conditions —the character of the sub-soil, the amount of traffic, the cost of materials. If the traffic is light, the sub-soil good, plenty of stone or gravel in the vicinity, a foundation of broken stone puddled with screenings or good gravel, thoroughly compacted, may be used and give good results. But where the traffic is heavy (and it must be considered that when a street or road is paved, the traffic over same will be greatly increased, owing to the improvement), or if the sub-soil is not reliable, then a more durable foundation, like concrete, should be used.

Local conditions also determine the thickness of the foundation. We observe a decided tendency to deepen the foundations and make them more permanent, and cut down the thickness of the wearing surface if possible. This, we believe, is a move in the right direction; but it should not be carried too far. The foundation should be designed to carry and distribute the load placed upon it and it should be no deeper than is necessary to do its work. Metal reinforcement is sometimes used in a concrete foundation over soft ground or lately filled trenches. The upper surface of the foundation course should be smooth, uniform, and parallel with the finished surface of the pavement. The smoothness of the finished pavement depends largely on the smoothness of the foundation and its uniform distance below the surface of the finished pavement.

Bedding Course—(Commonly called the sand cushion.)

The value of the plain sand cushion is being questioned by paving engineers. Many failures occur in brick pavements which can

be traced to the non-uniformity of the sand cushion or to a cushion not properly compacted. Many engineers take the ground that the only function of the sand cushion is to provide a uniform bearing for the brick wearing surface—the smooth compacted sand taking care of any inequalities of brick or any variation of the foundation. We believe that the thickness of the bed of sand should be as small as possible, never over one inch.

Laying brick on Illinois highway. Note steel side-forms, part of traveling template smoothing off the dry mortar cushion for the wire-cut-lug brick.

It it claimed that a grouted brick pavement should have a cushion so as to give it "resiliency" under traffic. We question if sand confined between a concrete foundation and a brick wearing surface has any real elasticity. We grant it may yield, shift or be compacted by traffic weight on the wearing surface of the pavement and that the cement grouted wearing surface will of itself spring back; but the sand will not follow, and we have a small air space between the sand and the grouted brick wearing surface. This can be easily demonstrated by a hammer survey of any cement grouted brick street laid on a sand cushion. The hollow spaces are readily located. These areas may be separated by solid areas where as yet the cushion has not left the pavement. The bond at these hollow spots may be intact and show no distress, but these areas become weak spots in an otherwise good pavement and eventually there may be a settling or a breaking of the cement bond.

It has also been claimed that a sand cushion prevents the crushing of the brick wearing surface under the weight of traffic.

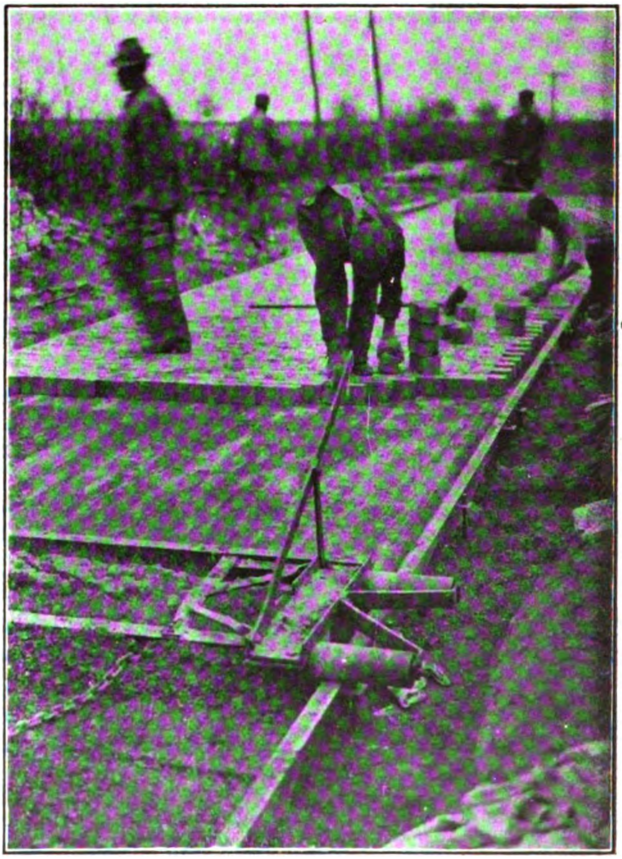
Mere weight does not crush a grouted brick pavement laid on a solid foundation, provided it has a firm bearing or bed for the brick. If paving brick manufacturers cannot make a paving brick that will bear the crushing force of street and highway traffic, they had better stop making brick.

Again, in actual construction, while we may give elaborate directions as to how the sand cushion is to be rolled and struck with a template, we find that to obtain good results in the field is almost impossible, and we have an unstable layer of sand varying in compactness and thickness between a solid foundation and a solid wearing surface. There is also the hazard of the sand working up between the joints of the brick and thus weakening the bond when the pavement is grouted.

Again, a rolled wet sand cushion, if it dries out after the bricks have been laid, will undoubtedly shrink and then leave hollow spots under the wearing surface.

In view of all the hazards of using sand for the bedding course, engineers are beginning to turn to the use of a mixture of cement and sand. Mr. Compton, Chairman and Consulting Engineer of the Baltimore Paving Commission, last year made laboratory tests of a cushion mixed 1 to 3, 1 to 5, 1 to 8, and 1 to 10, cement and sand, and adopted for all brick paving work this year in Baltimore

a cement sand bed mixed 1 cement to 5 sand. The sand and cement are thoroughly mixed dry and then handled the same as an ordinary sand cushion. The bricks are then laid, rolled and inspected, and the pavement wet down for grouting. This adds moisture to the cement sand bed and eventually the cement sand bed becomes hard and practically joints the brick wearing surface to the foundation. The rolling of the brick wearing surface is kept up even with the paver. This is an advantage, for if with a cement sand bed



Laying brick on Illinois highway. Note the construction of the traveling template, one end of which is shown. In front an I-beam and in rear a channel beam, supported on rollers and running on the side forms. Concrete base and mortar cushion are formed by one operation.

the paving is rolled and not grouted and we have rain, no harm is done; in fact the rain will set up the cement sand bed. On the other hand, there is always a hazard when it rains on brick laid on sand cushion and not grouted, as the sand is apt to come up in the joints from the wash, necessitating the relaying of sections of the paving. In Baltimore, Lexington Street, from Calvert street to Liberty street, was paved with brick in 1906, on a 4-inch concrete base, using a ½-inch mortar cushion, mixed 1 to 3. Mr. Compton states that this street stood up splendidly and that no complaint has ever been made as to noise. During the last three years the street has been all "shot" to pieces by sewers, gas, water, steam heating lines, etc., so that at present it is in bad shape from "cuts," but there were absolutely no failures caused by the original construction.

Another example of the durability of a grouted brick pavement laid on a cement sand bed is furnished by the paved approaches to the Pennsylvania Railroad Terminal in New York City.

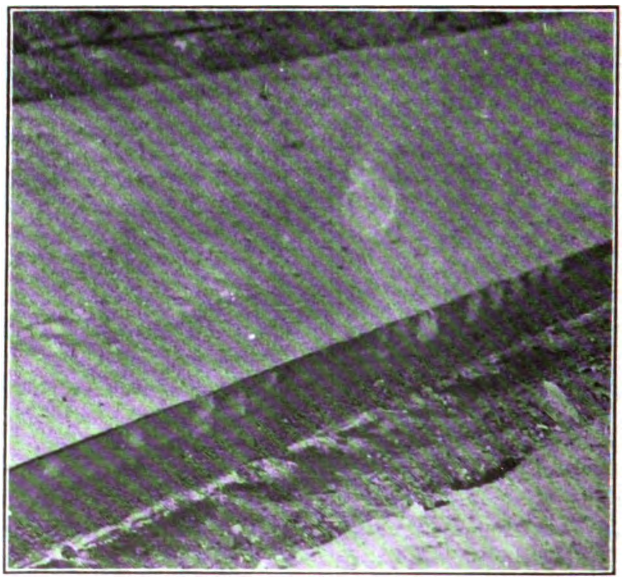
These approaches were paved in 1910, the bricks being laid on a cement sand bed mixed 1 to 3. The pavement today shows no signs of deterioration except along the curbs where the wheels of heavy loaded wagons skidding down the inclines have cut into the bricks.

The theoretical type of construction is that developed by Mr. W. T. Blackburn, of Paris, Ill., Consulting Engineer of the Dunn Wire-Cut Lug Brick Company, who assisted by Mr. Parrish, a local contractor, is laying the brick wearing surface direct on the freshly laid concrete foundation. This form of construction is attracting considerable attention from paving engineers and considerable mileage has been specified for roads in Indiana and Illinois, and has been thoroughly explained in the various engineering journals. Mr. Blackburn's specifications for road work in Edgar County, Illinois, using this form of construction are as follows:

> The foundation shall be four (4) inches in thickness with its upper surface finished to four (4) inches below the grade of finished pavement, and covered over with a thin coating of sand and cement, after they have been first mixed dry, to the depth of three-sixteenths (3-16) of one inch. In placing the concrete the operators shall be guided by a light wood template resting on side forms so made as to leave the concrete

a little in excess of depth required. Over this shall be drawn a steel template consisting of a six (6) inch I-beam in front and six (6) inch channel iron to the rear, placed in a frame two (2) feet on centers, supported by two (2) rollers at either end resting on the steel forms; the first section, or I-beam, should be three-sixteenths (3-16) inches lower than the channel iron, and cut the concrete base practically to a true surface four (4) inches below grade. In between these forms must be kept a sufficient amount of sand and cement thoroughly mixed dry. This rear template distributes this thin film of dry mortar over the surface of the base, leaving the surface entirely smooth. The template is one of the essentials of this type of pavement.

Upon this foundation and bedding course the bricks are laid in the usual method and are rolled with a hand roller weighing not less than twenty (20) pounds per inch of length. The rolling should be kept close to the laying and continued until the surface is smooth.



Completed brick highway in Edgar County, Illinois. Note monolithic appearance of the pavement on its edge, the concrete showing in part because not quite as smooth as the cement grout poured into the joints of the brick pavement. Surface still covered with sand layer for curing.

At the end of the working period the brick laying, inspection, and rolling shall be completed with the limit of the finished base.

The advantages claimed in using the cement sand bed or the new type of construction as developed by Mr. Blackburn are:

Elimination of the hazard of the sand cushion, as the pavement will not be injured at any time by rain, the wearing surface, with the exception of the filler, being completed each day. If a rainstorm intervenes no damage is done, as there is no sand cushion to become saturated and cause worry about rolling the brick surface.

Each brick in the wearing surface will be assured a cement bond its entire depth, for if the cement sand should work up in the joints, it will set up and prevent the shearing action which tends to crush the top of the brick.

There is no chance for the bed to shrink or shift away from the bottom of the brick wearing surface, as the brick is firmly bedded in the cement sand or held in the mortar of the concrete base.

Where these pavements have been laid there seems to be a total absence of any rumble under traffic.

Slight settlements and breaking of bond due to non-uniformity of sand cushion are eliminated.

In reference to the use of cement sand bed mixed 1 to 5, the increase in cost over a two-inch sand cushion will be from 5 to 6 cents per square yard, but Mr. Compton states that in Baltimore there has been no appreciable increase in cost due to its use in that city.

In county road work this type of construction eliminates the necessity of an edging, thus reducing the cost of the roadway.

Wearing Surface.

The wearing surface of a brick pavement is composed of vitrified paving brick laid close together and the joints filled with some material which will bind the brick units and protect the edges of the brick from chipping. The materials which have been more commonly used for this purpose are sand, various bituminous preparations and grout made of equal parts of Portland cement and approved sand mixed with water.

Grout filler is undoubtedly very much superior from a standpoint of durability. The bricks need the cement grout to protect the edges, and if the joints are properly filled the individual bricks are bonded together and the wearing surface is practically a monolith, and thoroughly waterproof. If square-edged bricks are used with proper expansion joints along the curbs, the noise of traffic is almost eliminated, (the rumble being taken care of by the use of cement-sand bed,) and the pavement surface is clean and sanitary as there are no open joints to collect street dirt and decaying material. These advantages have been recognized by municipal engineers, and cement grout is now used for a filler by all large users of paving brick both for city streets and highways.

The proper grouting of a pavement adds greatly to its life and the cement and sand should be carefully selected, uniformly mixed and then properly applied to the brick surface. Most of the specifications for brick pavements cover these points, but we will only emphasize that we believe that many pavements have been injured by poor sand or too much water in the grout. The sand should be clean but not too fine, and should be thoroughly mixed with the cement dry and then just enough water added to allow the grout to thoroughly penetrate to the bottom of all joints, but not thick enough to bridge them. A small batch concrete mixer properly equipped with a spout, etc., gives very satisfactory results in applying the grout; but all mixers do not work satisfactorily and the engineer should use care in the use of a mixer; their main fault is that the grout spills out of the drum before thoroughly mixed. After the application of the last coat of grout a close inspection should be made to make certain that all joints are filled flush with the brick surface.

In reference to expansion joints, the prepared bituminous joints (of which there are several on the market) are receiving the endorsement of paving engineers. The use of these joints removes the hazard of disturbing the grouted brick by removing the boards and then pouring the bituminous joint.

The quality, the shape and the method of making paving brick have been greatly improved during the last five years. Paving engineers have demanded certain requirements, as to size, shape, quality, and these demands have been promptly met by the manufacturers. All the leading companies now have their ceramic engineers who

are endeavoring at all times to keep their product up to the standard asked by the engineers. Abrasion tests are made from all kilns and from different parts of the same kiln. Engineers are encouraged to visit the various plants and observe the care taken in manufacturing. Paving brick manufacturers would welcome plant inspection of their product and all plants have a standard rattler which is at the service of the inspector.

On the demand of the engineers, the size of paving brick has been standardized. Paving bricks are now made 8½ inches long, 3½ inches wide and generally 4 inches deep, with certain small variations from these dimensions. When cement grout is used, many engineers are asking for a square edged brick with rough sides and contact lugs, as investigation has shown that a better bond and a smoother wearing surface can be obtained with this shape of brick than by a smooth brick with rounded edges. The specifications of the Board of Water Supply, New York City, for roads in their reservoir district, read:

"The blocks shall have square edges, with wire-cut or otherwise satisfactorily roughened side surfaces for the adhesion of the filler. The blocks shall have suitable lugs and grooves for properly spacing and bonding them in the pavement, of such dimensions that joints will not be less than 3-16 inches wide nor exceed 3-8 inches, and will be thoroughly filled."

The specifications of the City of St. Louis, Mo., read:

"The bricks shall be unrepressed, side wire-cut in such a manner that the lugs will be formed during the process of cutting and shall have the ends beveled."

We cite these specifications from extreme parts of the country to show that engineers are investigating and deciding for themselves what they want and the manufacturers must meet, and are meeting, all reasonable demands.

With the advent of the cement sand bed there is a tendency among paving engineers to reduce the thickness of the brick wearing surface. Why use a brick four inches thick if it is possible to bind the wearing surface and the foundation by means of a mortar bed? No brick pavement has ever failed by the actual wearing away of the brick surface. Consequently bricks 3½ inches and even 3 inches

in depth are now being specified. Mr. Blackburn is laying 3-inch wire-cut lug bricks on rigid concrete base on the roads of Illinois; and the Board of Water Supply of New York City are using 3½-inch wire-cut lug bricks on roads around their reservoir. This saves considerable money for the taxpayers as there is a large saving in material, freight and haulage.

The laying of brick on a mortar bed raises the question as to the strength of the bond between the concrete base and the bottom of the brick. Unquestionably, Mr. Blackburn's method of laying brick assures the nearest approach to a perfect bond and a perfect beam.

As beams vary in strength as the square of their depth, a three-inch brick laid in a mortar bed on four inches of concrete would have a beam strength of forty-nine, while a four-inch brick laid on a two-inch sand cushion on four inches of concrete would have a beam strength of thirty-two. This opens the field for the economic design of pavements.

Discussion of this paper will be found on page 162.

VERTICAL FIBER BRICK PAVING.

By A. D. DUCK, City Engineer, Greenville, Texas.

Since the introduction of vertical fiber brick paving, nearly three years ago, by the Western Paving Brick Manufacturers' Association, considerable attention has been drawn to this type of pavement, especially in some parts of the south, and it is evident, from the increasing yardage, that vertical fiber brick is a worthy addition to the field of paving materials.

The writer is informed that this type of pavement originated with the success of a two and one-quarter inch, repressed vitrified brick, laid flatways, on Lee Street in Greenville, Texas, in the year 1906, and it might be of interest to know that this same city of northeast Texas was the first municipality to lay vertical fiber brick, as standardized by the Western Paving Brick Manufacturers' Association.

During the construction of Lee Street, as noted above, the brick were laid flatways to cover additional yardage only, as no particular test was intended. The street was constructed under the supervision of L. W. Wells, at present chief engineer and general manager of the Texas Midland Railroad Company.

The brick were laid on a 5-inch concrete foundation, a 1-inch sand cushion and a cement grout filler was applied to the surface. Contrary to modern methods, no expansion joints were provided at any point, altho the street was paved forty feet in width. This street, after nine years of traffic, is still in a serviceable condition, regardless of the fact that a street car track has been laid and numerous other openings have been made since the completion of the pavement. The accompanying photograph indicates the present condition of this pavement and, notwithstanding the fact that replacement of openings was mostly done by inferior and indifferent workmen, the city has not, so far, expended a single dollar for maintenance. The favorable results from this pavement were responsible for the selection, by a majority of the taxpayers, of a similar type of pavement and award was made in February, 1913, for approximately 90,000 square yards of 2½-inch vertical fiber brick.

Two and one-quarter inch repressed brick pavement, Greenville, Texas.

The specifications were drawn and the contract awarded a few days prior to the time that the writer assumed charge of the work and very little investigation was necessary to learn that the specifications were drawn without proper consideration of the essential features.

The crown, on the widest streets, namely, forty feet, was not to exceed four inches, an insufficient amount when no adequate drainage was provided for.

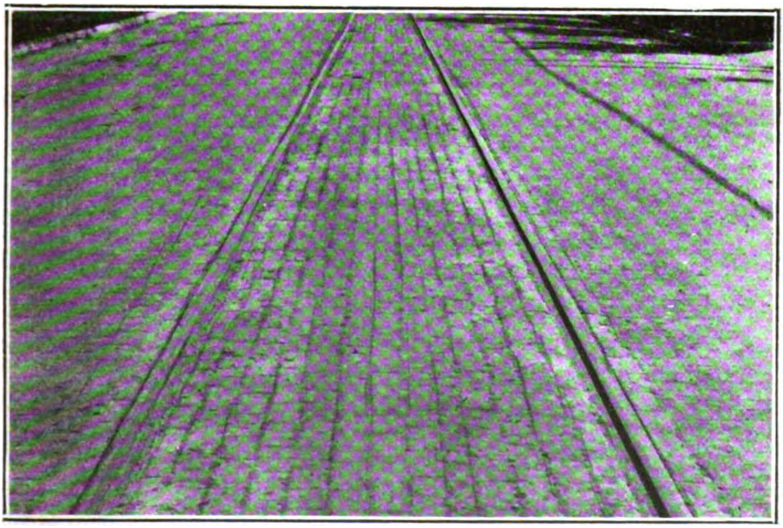
The curb was specified as follows: Depth, 16 inches; average thickness 5½ inches. Curb to be reinforced with two ⅜-inch steel rods. No allowance was made for expansion, regardless of the fact that temperature changes amounted to as much as 110 degrees.

The sub-grade should have received the most careful consideration as to drainage and preparation, on account of the peculiar action of the soil during the hot dry seasons. The earth is subject to an excessive amount of contraction, causing large seams to open in every direction. The writer has often seen openings from three

to five inches in width, extending twenty or thirty feet in length and over five feet in depth. Back of the curb line the earth is often drawn three or four inches away from the curb to its full depth, leaving an unsupported curb to meet the expansive force of the pavement. No consideration was given to this feature and no underdrainage was provided for.

The following extracts from the specifications and contract will show that no provision was made to meet local and peculiar conditions:

"Said specifications are to be construed according to the letter thereof and no deviation therefrom shall be allowed; for instance, said specifications provide that sand and gravel used in the improvement shall be free from loam, clay, foreign substances, etc., and it is hereby agreed that sand and gravel containing the least particle of the above named articles shall not be allowed, and said specifications shall be strictly and literally construed in every particular and it is agreed that if the contractor does not strictly and literally follow the specifications in performing said work, all assessments hereunder are void, and it is further understood and agreed that any city official or any property owner may inspect the work at any



Photograph showing present condition of street car track.

Two and one-half inch vertical fiber brick. Asphalt filler.

time and may take samples of the material on hand for the improvement for the purpose of making tests. The city engineer nor other person shall ever put any other construction than the above on the specifications."

Considering the above statements, together with the fact that the authority of the engineer was curtailed, it is evident that good results were not obtainable. These items have been offered to illustrate some of the conditions under which the pavement was laid and also to show what an engineer may encounter in some of the smaller municipalities that have failed to adopt standard specifications. The above facts must also be considered before any criticism can be justly made of the final results.

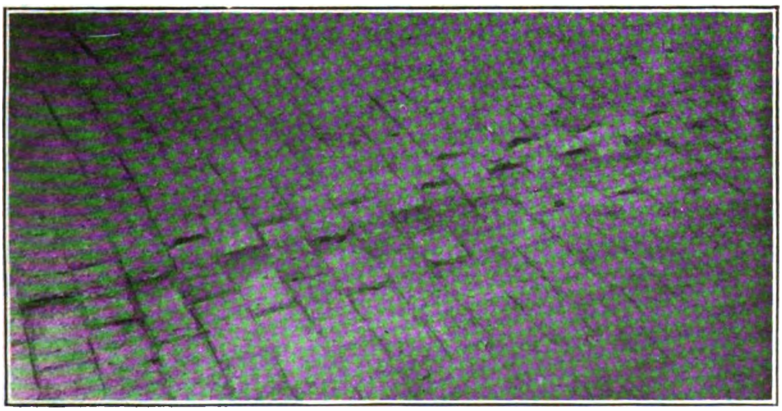
Before construction was started the writer requested authority to make various changes in the plans and specifications in order to eliminate some of the impossibilities and to secure better results. Authority was not granted and the writer started the construction of an experimental type of pavement under adverse conditions.

The sub-grade was prepared and thoroly rolled with a 10-ton roller. Each 1,000 square yards received at least 5 hours continuous rolling. On this sub-grade was placed a 4-inch, bank-run, gravel

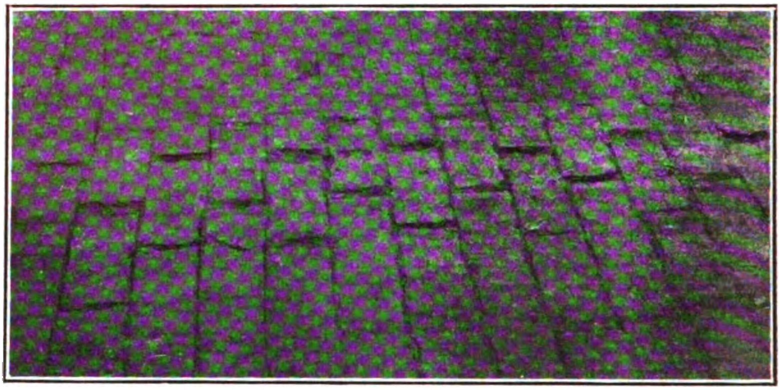
concrete. A 1½-inch sand cushion was then spread with a suitable template. (No provision made for the rolling of this cushion.) The wearing surface, 2½-inch vertical fiber brick, laid flatways, was then placed and rolled with a roller having a compression of 250 pounds per linear inch of tread. To this surface was applied a hot bituminous cement coating. No melting point, penetration or other requirement being specified, any grade of bituminous cement could be used, regardless of its unfitness. A thin layer of sand was then applied and the street opened to traffic.

With the aid of the manager of the street railway company the writer was able to have several streets readvertised for bids, in order to eliminate a freak design for street car track construction and to substitute a simple but substantial plan. For the wearing surface between the rails, special-shaped filler and nose blocks were made so as to permit the brick being laid parallel to the track, thirteen bricks being required to fill the space between the rails. This type of construction permitted the brick to be laid without batting and after the application of the bituminous filler a rigid and impervious surface resulted. After two years of traffic no disintegration has appeared.

The contract price for completed pavement (including excavation the thickness of the pavement) was $1.70 per square yard; street car track construction $2.52 per linear foot.



Seams due to earth contraction and sub-grade movement.



Spreading of wearing surface on account of expansion joints.

The brick used in this work were made at Boynton, Okla. Standard abrasion tests were made of average samples, after delivery, and at the place of manufacture. The results were within the requirements of the specifications.

Upon receipt of the first consignment of brick, the writer selected twelve average samples for the purpose of testing absorption and wearing qualities.

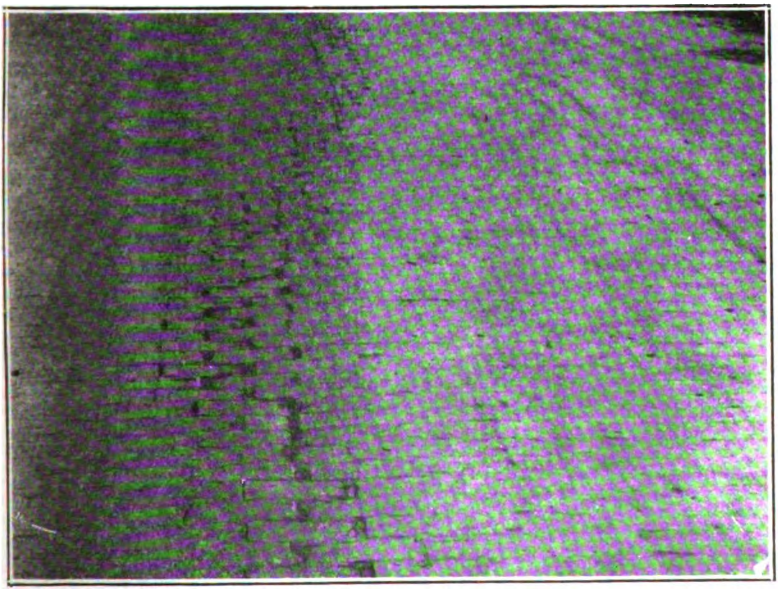
The samples were dried for a period of twenty-four hours and weighed, immersed for a like period and reweighed, with the following results:

TEST NO. 1. 2½-INCH VERTICAL FIBER BRICK.

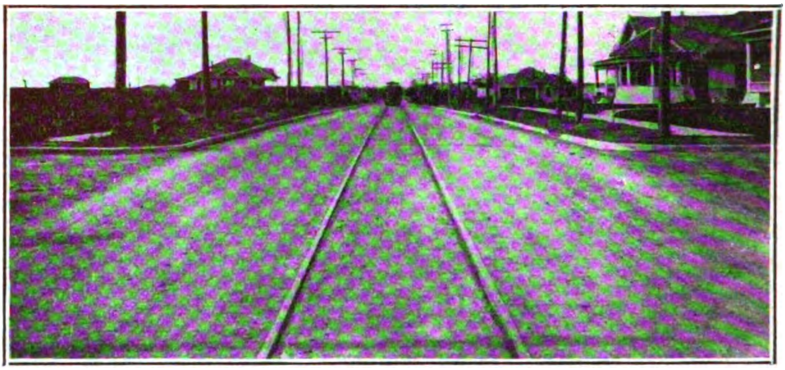
	WEIGHT		ABSORPTION	
Sample No.	Dry. ozs.	Wet. ozs.	Ounces.	Per cent.
1	117½	122½	5	4.25
2	118	122½	4½	3.81
3	116½	121	4½	3.86
4	118	123	5	4.23
5	120½	126	5½	4.56
6	118½	124	5½	4.64
7	118	122½	4½	3.81
8	118½	123½	5	4.22
9	119	123½	4½	3.78
10	117½	122½	5	4.25
11	118½	124	5½	4.64
12	118	122½	4½	3.81
Average	118	123	5	4.15

The samples were then placed during construction at well defined locations and were subjected to ordinary traffic for a period of about twenty-five months. The samples were then removed, cleaned and tested under the same conditions as at first, with the following results:

	WEIGHT.		ABSORPTION.		REMARKS.
Sample No.	Dry. Ozs.	Wet. Ozs.	Ounces.	Per cent.	
1	108	115	7	6.48	
2	108	113½	5½	5.09	
3	107	112	5	4.67	
4	...	...	..	...	Broken
5	111½	116½	5	4.52	
6	110	115½	5½	5.0	
7	109½	113½	4	3.65	
8	109	115	6	5.50	
9	109½	114½	5	4.56	
10	...	...	..	..	Broken
11	108½	114½	6	5.53	
12	109	113	4	3.67	
Average	109	114.3	5.3	4.86	



Seams due to earth contraction and sub-grade movement.



Vertical Fiber Brick Pavement after two years' traffic.

By comparison it is readily seen that in a period of about two years the brick lost in weight an average of nine (9) ounces or about 7.63%. This loss was due to the wearing away of the roughened surface and took place in a period of sixty days after the disappearance of the asphaltic protection coat. The slight change in absorption is of little importance and the irregularities noted were due, no doubt, to the retention of small particles of bituminous cement at the time of the last test.

The movement of the sub-grade, as previously noted, made its appearance during the early part of the construction work. Experiments were made with the sub-grade, to determine if possible, what degree of moisture would give best results. By observation of the first few streets constructed, it was found that a very moist sub-grade, with gravel or stone rolled in, gave less trouble from movement than one thoroly compacted. This was due, no doubt, to the retention of moisture long enough to pass the dry season.

The streets that were laid upon sub-grades prepared in the usual manner, have been attacked by contraction, causing the concrete base to fail and open in ragged seams, in some cases as much as three inches. This permitted the sifting of the sand cushion, leaving the brick unsupported. The filler being unable to retain the brick in place, very little traffic was necessary to force the brick out of alinement. The attached photographs show the action of contraction on the wearing surface. This same peculiar earth movement

has caused the bulging, to a very great extent, of other types of pavement in Greenville, but on account of the pliant wearing surface, no seams have opened in the surface of any bituminous pavement.

The first item in the specifications to cause trouble was the placing of continuous reinforcement in the curb. This was overcome by making a thru expansion joint at each 24 feet and at return curbs. This has prevented buckling to a great extent, and the rods when properly placed, aided in keeping the curb in alinement. A 1-inch bituminous expansion joint was to be provided at each curb line and a number of streets were laid before the writer could omit them. Spreading of the wearing surface has resulted on every street laid with the joints. The seams, caused by this spreading, do not affect the wearing qualities of the pavement, but detract from its appearance to a great extent. Omission of the expansion joints has materially lessened this defect.

The specifications stated the following: "The top surface shall be rolled with a roller weighing not less than 250 pounds per linear inch of tread." This amount of compression forced the sand, in places, to the top of the brick, and the use of a lighter roller being forbidden, a heavy sand containing about 15 per cent of clay was substituted with good results. The heavy roller shattered a great number of the brick by compressing them against some of the larger pebbles contained in the sand, and the replacement of the broken brick resulted in a partial destruction of the contour of the pavement.

The specifications further stated that the spreading of the sand on the surface should not take place until the bituminous cement became dry, and then made to adhere to the brick. Such poor results followed this method that an asphalt having a proper penetration and melting point was applied at a temperature averaging 400 degrees and the sand placed immediately after the spreading of the filler. This gave good results, and at present some of the streets retain this surface.

In the above article the writer has made no attempt to discuss vertical fiber brick from the manufacturer's point of view, but for those who may desire such a discussion attention is invited to an article on "Vertical Fiber Brick Paving" by James I. Tucker, Director of the School of Civil Engineering, University of Oklahoma.

By a comparison of this pavement with several other types in the same city, it is found that during the excessive heat of summer about ten per cent more dirt accumulates along the curb lines, due to the softening of the asphalt filler, and when ground in by traffic the ordinary broom sweeper or flusher fails to dislodge it. This one item is about the only objection the writer finds and in towns that have no adequate system of street cleaning, this objection is not serious.

Repairs are easily and quickly made by unskilled labor, and the only equipment necessary is a small kettle for heating the asphalt. The writer has repaired nearly eighty openings since the pavement was completed at an average cost of sixty-eight cents per square yard. This cost included the cleaning of bricks, replacing concrete base, sand cushion and applying the necessary filler. After a few weeks' traffic a close inspection is necessary to determine where the original pavement had been disturbed.

The claim of the manufacturers that this pavement is the most noiseless pavement known, is hardly a point for discussion for, on account of the increasing use of motor vehicles, pavements, excellent in every other respect, which were formerly discriminated against on account of the excessive noise that horse drawn vehicles made on them, may now be freely used, because it is doubtful if a motor vehicle makes more noise on any one kind of pavement than on any other.

The cheapness in first cost, ease of construction and repair and its evident stability seem to be features that make this pavement worthy of serious consideration in the selection of a street pavement, especially in the municipalities that are unable to maintain expensive repair equipment and experienced workmen, and little investigation is necessary to convince most taxpayers that a properly constructed vertical fiber brick pavement will at least enhance the value of any property to the extent of the financial outlay necessary for such an improvement.

DISCUSSION

Of Papers on Brick Pavements.

Mr. Christ: In regard to this last method of construction: I do not care to discuss it at the present time, because I think it is in its infancy and will need investigation. Mr. Blair referred to

rolling of the sand cushion, that it was impossible to do it with one rolling. I am afraid that he has not read the specifications of this Association in regard to that matter. I found the same trouble that he did, but I corrected it in this way. We lay a guide timber next to the curb and center of street an inch and a half in depth; that is the depth of the sand cushion after rolling. Before shaping the cushion a ½-inch strip is laid on these guide timbers, and the template is drawn over the same, after which the ½-inch strips are removed, and the sand is rolled with a hand roller. After the rolling, the template is drawn over the curb and guide timbers or rail, to complete the cushion; and the operation is one operation and has given perfect satisfaction where used. I found in laying sand on the foundation without any guide to go by, that they frequently did not get enough to make the inch and a half after rolling, and it left low spots in the cushion, that were practically impossible to fill because the second screening with the template would scrape it all off again. So if Mr. Blair will kindly read sections 13 to 16, page 13 of the specification in regard to sand cushion, he will find a method that will only need one rolling.

In regard to his grouting: In Grand Rapids, unfortunately, one contractor has practically laid all of the brick pavements, and his grouting has been bad every year. For two years I have made an effort to have the city engineer pay closer attention to the sand that he was using for grouting. The engineer said he thought it was in the cement. I said I did not believe it, for I have used four different kinds on one street with great success. This engineer agreed to make a test of the cement and sand, but he never did. This spring we had a new engineer and he let this same contractor furnish the same sand for grouting that he had been using. I warned him of it, and when he had about three blocks down he noticed the grouting was filling in the top of the brick. When it rained, it showed all wet; showed there was absorption in that grouting. So he immediately stopped him, and took some of the sand and cement to the office, made up briquets and they tested 105 pounds. He then obtained the sand that we require in the specifications and made up briquets and they tested 460 pounds.

President Howell: After a seven days' test?

Mr. Christ: Yes, sir.

PRESIDENT HOWELL: One to three?

MR. CHRIST: One to one.

PRESIDENT HOWELL: In our city we have a one to three test, demanding 150 pounds for seven days' setting.

MR. CHRIST: This is a one to one, and I am giving you the figures that he gave me. The contractor then finished the balance of that pavement, and the work done since then shows the grouting is perfect, and the rain has no effect on it. I believe that is the trouble with most grouting. I have heard it expressed here by different members that they do not like to put in a soft grout in the beginning. I prefer it, for the simple reason that you get grouting that will penetrate to the bottom of the brick.

MR. BLAIR: In reply to the observation of Mr. Christ with reference to the manner and method of compressing the cushion as set out in the Society's specifications, I will say that I have thoroly read that and tried it, and I want to say this: Mr. Christ has a very remarkable sand in all western Michigan, something that we do not have all over the country, and Mr. Christ has the advantage of having just as good sand for that particular purpose as he always has in the quality of brick for brick laying, because Mr. Christ is a very particular man and he lays splendid pavements. But as I go over the country I frequently find sands of quality which can not be manipulated so easily and readily as the sand which is available for use in his territory. These sands can not be compressed so well by rolling and striking off the surplus as by a process of rolling, filling up, re-shaping and re-rolling, and repeating the process three or four times. I have been entirely unable to secure what is really desired, a uniform and thoro compression of the sand cushion, in any other way than this. It is so important that this shall be done in order that we may have a complete and uniform support for the monolithic wearing surface of brick, that any means to secure it ought to be resorted to.

MR. HARRIS: I would like to ask if you can use the cement-sand cushion in connection with a city street pavement. It seems to be a comparatively easy proposition on a country road, on account of the narrowness, but can it be applied to a paving proposition in a city?

MR. BLAIR: Mr. Blackburn is present, and he can answer that better than I can.

MR. BLACKBURN: This type of pavement was worked out on a country highway; however, last summer our city had specified standard construction on one of our heavy traffic streets. We secured the consent of the property holders and built this street twenty-six feet in width by the same method as that used on the country road. The template was drawn by the mixer. With this sort of construction it would be necessary to devise some means of drawing the template other than the mixer. The construction of the concrete base would necessitate the moving of the template at a different time than the time you are perhaps ready to move the mixer.

The mayor of St. Louis and party saw us building these roads and it was thought it could be done in their city in the same way. They specified this type for a 36-foot street. They were unable to draw the template and it was necessary to first construct the base, immediately following with the dry mortar cushion, upon which the bricks were laid and rolled, building the base in two operations instead of one. I have no hesitancy in saying that this type of construction can be readily made.

The matter of the template is left with the engineer with the wide streets.

MR. PERKINS: It has been suggested that on a wide city street it might be possible to build half a street at a time by this method, where you have a mortar bed which would not break down. How about that?

MR. BLACKBURN: That is one of the things in the country we have some difficulty with. The Kelly boys of Portsmouth, built a road where 1600 feet of it had to be kept open to traffic all the time. They excavated one-half of the roadway, put in their foundation and brick, and completed the pavement and let them use the other side of the street all the time until this was thoroly set up, and then took up the other side. With a very wide street I think you can do that.

MR. BLAIR: I think anyone who observed the working of this in Illinois, would say that so far as building a wide street is con-

cerned it can readily be seen that the form can be blocked out so you can build one-third or one-half of the street, or such a section as you please. I believe that can easily and readily be done.

Mr. Christ: I have had occasion to lay a street 48 feet wide where it necessitated laying one-half of it at a time. The only trouble I found was I could not get any straight courses across the street connecting the brick in the center, in the dove-tailing. We had a great deal of trouble in connecting our pavement; we had to cut some of the ends of our brick to catch up or fall back upon.

SOME EXPERIENCES IN CREOSOTED WOOD BLOCK PAVING.

By Ellis R. Dutton, Assistant City Engineer, Minneapolis, Minn.

Reasons.

The reasons for presenting this paper are twofold.

1st. For the purpose of recording the observations of the effect on creosoted wood blocks from the ordinary use of the same for an extended period of time, having the data as to the preservation and wood used.

2nd. That having these data and experience, more reliable inferences and conclusions can be reached as to the probable results that will happen in the use of certain materials in creosoted wood blocks.

Remarks.

Experience is the best teacher in all things, and particularly so in regard to matter pertaining to paving and road surfaces. Time is the surest test used by this teacher, and gives the best and most reliable information to guide us in the future.

Quite a few years ago there were large areas of cedar block pavement laid. This was considered a great improvement over the pavements then in use, and made a much pleasanter pavement to drive over, as the noise was greatly reduced and was much smoother than other classes of pavement. This all looked well and sounded well when it was explained by the promoter. But, as time went on it was learned by experience that all was not as expected or represented, and that the pavement began to get rough and that it began to show rot.

Then came a new promoter and he had a smoother and better pavement, the so-called "Nicholson" block, which was smoother and was *preserved* by coating with tar, and so that was tried. But, experience with time as the test, showed that this class of pavement as well as the cedar blocks was a failure.

The people then, after seeing this, went back to the stone blocks or brick, as they knew by experience that no such thing as rotting would destroy that class of pavement.

Soon, however, there was placed on the market another wood block pavement, as they could not get away from the fact that the wood made the best surface when it was new. This new block pavement was called "Creosote" and was evolved from the fact that the previous wood block pavements had failed because of the rotting or decay, and that dead oil of coal tar had been used successfully to prevent rotting or decay in timber and piling. Failure, however, attended the first introduction of this pavement as the rectangular blocks used were only dipped or soaked in the creosote oil and only retained about three pounds of oil per cubic foot. This was not sufficient to prevent decay nor enough to prevent the moisture from entering the blocks and causing expansion. But they were on the right track—"Prevent Decay"—and it would only require more oil and a method to get it into the block. This was carried on until about 1900, when they had made a better quality of oil and had invented a catch trade name for it, and concluded that twelve pounds of oil would do the business.

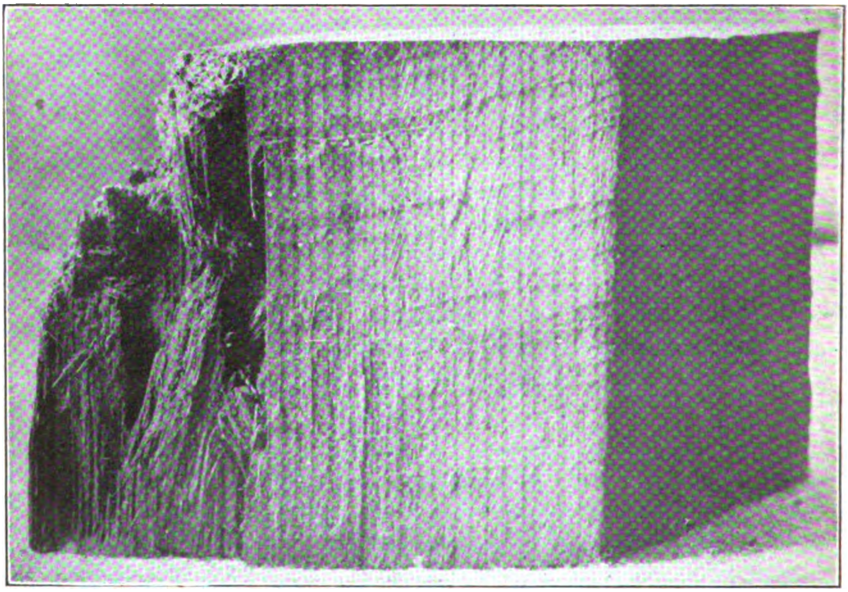


Plate 1. Yellow Pine block treated with 12 lbs. of oil and laid in 1902, showing decay and method of failure. Also showing penetration of about ¼-inch in the heartwood. Cause of failure: Insufficient amount of oil and penetration.

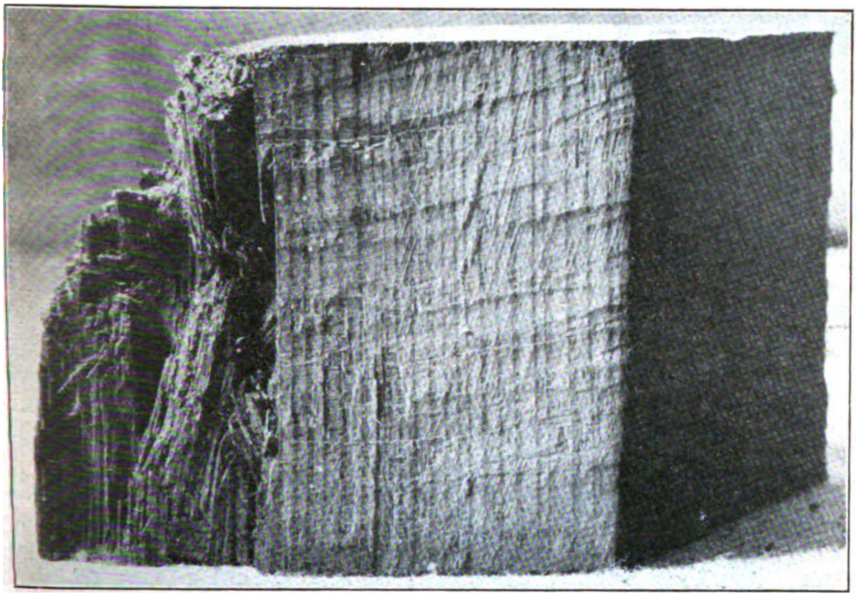


Plate 2. Yellow Pine block treated with 12 lbs. of oil and laid in 1902, showing decay in the interior of the block, and traffic pushing the fibres downward. Cause of failure: Insufficient amount of oil and penetration.

Then the promoters went forth again with the trade names and the dark secrets as to the constituents of the oils and the methods of treatment and with a guard around the plants so that no one could possibly see or learn any of the trade secrets, they were safe in telling the people what a great thing the new paving was.

Under these conditions some of the first paving of this class was laid, and it was a vast improvement over the former wood block pavements. These promoters, however, were up against the popular prejudice against wood for paving purposes, as the public had learned by past experience, and they did not want to have another repetition of wood block failure. Gradually, however, the public saw that this wood block was different from what they had used and began to try it, so that the amount of creosoted wood block pavement in use today amounts to about 9,500,000 square yards.

The ordinary commercial creosote oil at that time had a gravity of about 1.02, and the trade-name oil had a gravity of about 1.07

at 38 degrees centigrade, and contained some heavier and darker material than the ordinary creosote oil. There was no inspection and no one except the originators knew very little about creosoting or how much or what penetration was required to preserve the block. The results as shown by the time test of experience on the pavements of 1902 and 1903, clearly indicate that the penetration and amount of oil per cubic foot was not sufficient to preserve the block, and that it had decayed and broken down, as shown in the photographs Nos. 1 and 2, of a yellow pine block laid in 1902.

Or in the next photograph, No. 3, of a Norway Pine block laid in 1903.

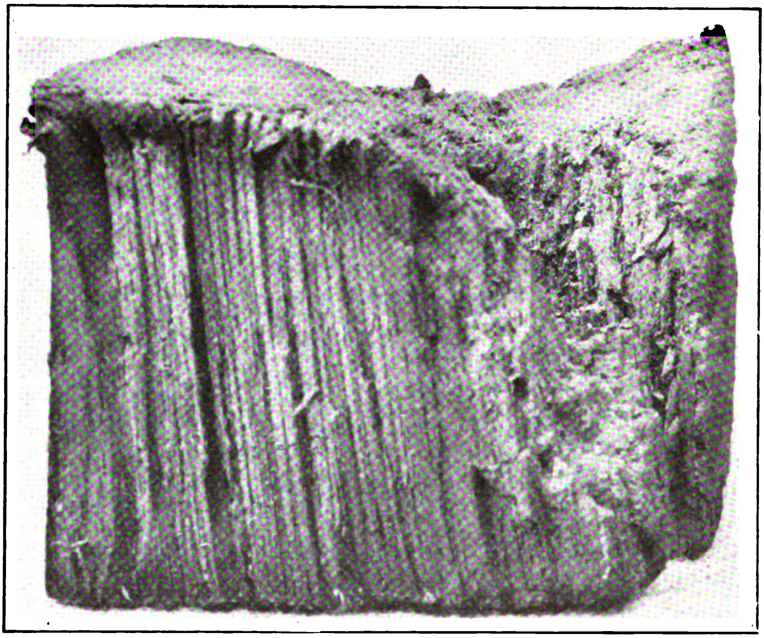


Plate 3. Norway Pine block treated with 12 lbs. of oil and laid in 1903, showing decay in the sapwood all the way thru. Cause of failure: Insufficient amount of oil and penetration.

This experience here cited would clearly show that the pores of the wood must be thoroughly penetrated if the block is to be preserved. It also shows further that all parts of the same block are not equally penetrated and that a part of the block has taken a great

deal more oil than the specified amount, and that another part has a very much less amount. This is the principal reason why the amount of oil per cubic foot should not be reduced below an amount which would be required to penetrate *all* the block. It shows plainly that the 12 pounds per cubic foot was not sufficient to prevent decay.

The oil used in the treatment of wood blocks in the City of Minneapolis in the various years has been as follows:

Year.	Lbs. per cu. ft.	Ave. Sp. Gr. 38° C.	Per Cent 210° C.	Distillate 235° C.	up to 355° C.	
1902	12	1.071				Kreodone
1903	12	1.070				"
1904	12	1.072	5.91	19.60		49.6 at 315° C.
1905	16	1.070	5.59	26.19	75.54	
1906	16	1.074	5.14	22.95	69.22	
1907	16	1.069	6.74	24.53	69.42	
1908	16	1.097	2.49	10.78	51.34	
1909	16	1.110	1.93	9.37	48.57	
1910	16	1.102	3.45	16.39	56.49	
1911	16	1.104	3.21	15.39	56.78	
1912	16	1.121	4.39	11.61	42.33	
1913	16	1.114	4.62	13.57	48.78	
1914	16	1.116	3.12	10.23	45.26	

From the table it will be noted that up to 1908 an oil of a specific gravity of 1.07 to 1.08 at 38 degrees centigrade had been used, and from that time to the present an oil of a specific gravity of 1.10 to 1.12 at 38 degrees centigrade has been used. There has been no difference as far as penetration is concerned on account of the quality of oil, nor any difference as far as the bleeding is concerned, so far as we have observed. As far as we have been able to determine by analysis and tests there has always been what is termed tar or tar oil present in the oil used to a more or less extent, although the contractors claimed otherwise, but the expert chemist admitted that it was ***tar base.***

There are four functions that an oil should possess to be a proper oil for paving purposes:

1st. It should be a preservative.
2nd. It should be water-proofing.
3rd. It should be penetrating.
4th. It should be non-volatile.

The amount of oil required to preserve the wood block is variously estimated at from three to eight pounds, varying as to the condition under which it is used. Not all the constituents of an oil are preservatives, and some of these are quite volatile, so that unless a high impregnation is used the wood is not preserved, the oil evaporates and is washed out of the wood allowing water to enter and cause swelling, bulging and decay. If you add to the oil a waterproofing material, be it a tar or the higher boiling fraction of a creosote oil, and properly impregnate the block, you reduce the volatilization, keep the oil in the wood and keep the water out of the wood, and then conform to the conditions above outlined.

In regard to the quantity of oil to be used: There have been different opinions, and the pendulum has swung from too little as in the first blocks laid in 1902-3-4, in Minneapolis, to too much in cities where they have used 20 pounds and more. Minneapolis was

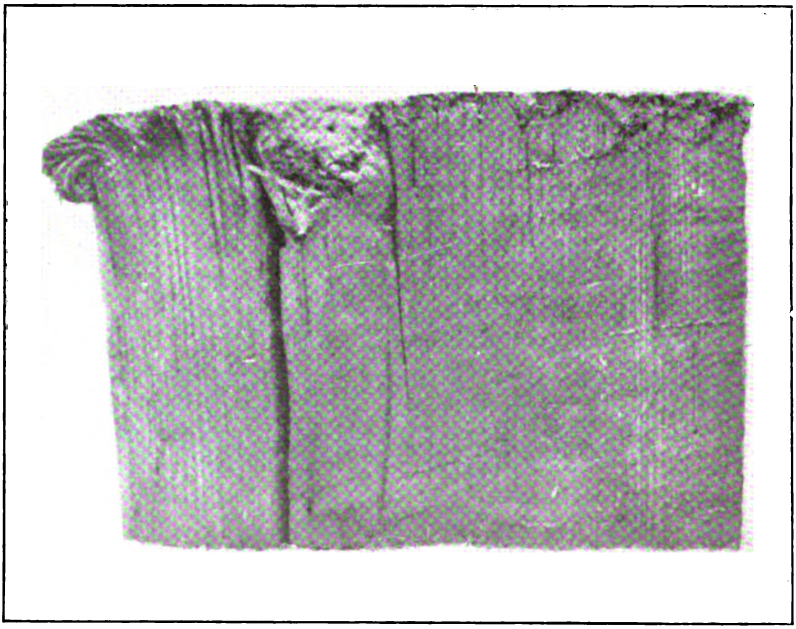


Plate 4. Norway Pine block treated with 16 lbs. of oil and laid in 1905. This block shows thoro penetration and the oil is still in the block. No decay because of sufficient oil and penetration.

the first city to use as high as sixteen pounds, and has never used more, and I think that it has preserved a happy medium, as the resulting pavements have shown.

Another objection raised against the use of a mixed creosote and tar oil is that it does not stay in the block, but evaporates or gets away. You will note in the photograph No. 4, which was a block removed in 1915 from a pavement laid in 1905, and photograph No. 5, which is a block removed in 1915 from a pavement laid in 1908, that the blocks are well penetrated by an oil with a decidedly

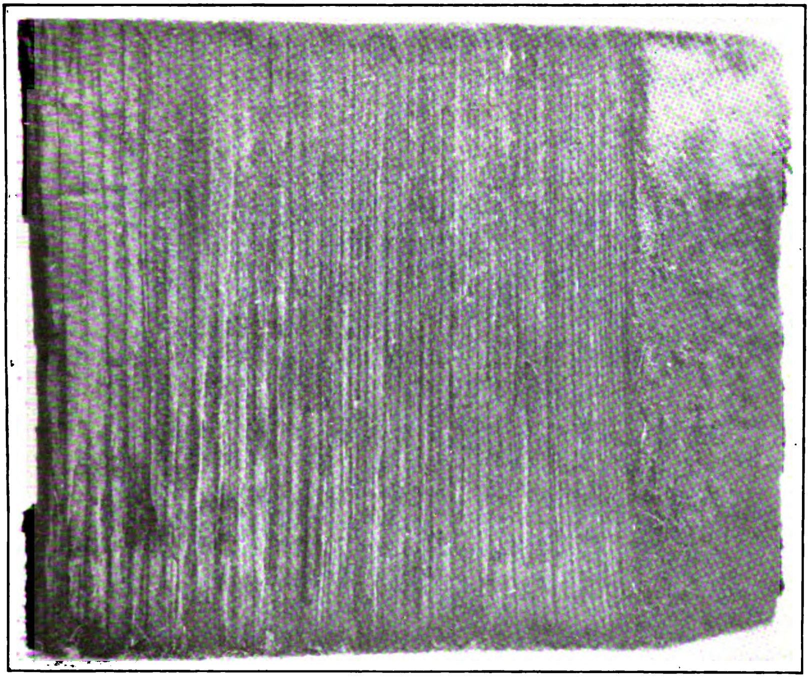


Plate 5. Norway Pine block treated with 16 lbs. of 1.10 gravity tar oil and laid in 1908. No indication of any appreciable evaporation of the oil, and showing penetration. No decay because of sufficient oil and penetration.

black color and that it is still in there. By using a smooth dull instrument and pressing against the wood, the oil was pressed out quite freely, showing that there was sufficient oil left in the block after a lapse of eight to eleven years of use.

Woods.

From all the observations of the use of different woods it would appear that the Yellow Pine used in 1902 was the best for the purpose under rather heavy traffic, but the Tamarac used later shows up very well on lighter traffic streets. As you are aware, Minneapolis was a great lumber center, and in 1903 the lumber interests thought it was a reflection on them that the city should *import* Long Leaf Pine from the south to use for paving, and prevailed on the Council to use the Northern Norway Pine. I did not think this advisable at the time, and time and experience shows that it was not. The hardness or density of the block varied so much that the wear was uneven, which you can see in photograph No. 6; a large part of the depression being caused by this reason.

Plate 6. Norway Pine block laid in 1903, showing the uneven wear on blocks of varying hardness, causing depressions in the surface of the pavement. End block shows original depth.

On Central Avenue, which was paved in 1905, and where the traffic is the heaviest in the city, the blocks have worn down about two inches, and the comparison with the original block is shown in photograph No. 7.

Plate 7. Norway Pine block laid in 1905 on street having quite heavy steel tire traffic.

The total average wear up to the present time on the 1902 Long Leaf Pine has been about one-eighth of an inch, and on Norway laid in 1903 about three eighths of an inch, under practically the same condition.

In the Government experimental block laid in Minneapolis in 1906, the results are similar to those mentioned above, although there were many more varieties of wood used. A wood in which the fibre is not stiff enough to withstand the traffic and pounding begins to broom up and lay over in the direction of the traffic, will soon wear away and cause depressions in the pavement. You will notice this plainly in photograph No. 8 of a Fir block laid in 1911 in the Government experimental block on Nicollet Avenue between 2nd Street and Washington Avenue.

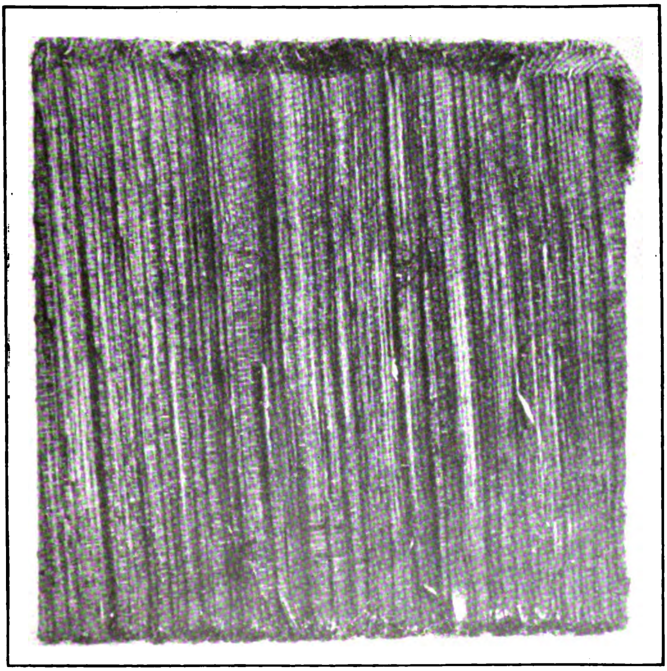


Plate 8. Douglass Fir block laid in 1913 showing the brooming effect and forcing the fibre in the direction of traffic. This block from the experimental section.

From all the data at hand and observations and reports from other places, it seems unwise to creosote and use for paving purposes any wood except that which has proven the most durable and which can be procured at a reasonable price. It does not pay to use a wood because it is cheap, as the cost of repair and renewal soon overcomes the cheapness, and in the end makes it the most expensive.

These remarks have all been on the defects in creosoted wood blocks and may leave a wrong impression in some persons' minds as to the most excellent quality of such pavements. I would say that there are in the city of Minneapolis today, about 1,500,000 square yards of creosoted wood blocks, and that the yardage of the defective pavements mentioned above is only 27,730 square yards, or 1.85 per cent of the total. The cost of maintenance and repairs of creosoted wood blocks was only 0.09 cents per square yard for the year 1914 on the total yardage, so you can see that the cost is very low considering the age of the pavements. Even the low cost was not all entirely due to the failure of the blocks themselves, but was caused by other defects, so that this cost could be reasonably reduced fifty per cent and still be charging creosoted wood blocks with all that they should stand.

Results.

From the foregoing observations and experiences on the results of the test of time on creosoted wood blocks for paving purposes, we can draw definite conclusions as follows:

1st. As to the quality of the preservative.
- A. It must prevent decay of the wood.
- B. It must waterproof the wood.
- C. It must penetrate the wood.
- D. It must remain in the wood.

2nd. As to the quantity of the preservative.
- A. The quantity may vary in different kinds of wood, depending upon the porosity. But
- B. The quantity must be sufficient to permit the penetration of all parts of all blocks in all charges; experience showing sixteen pounds per cubic foot to be sufficient but not too much.

3rd. As to the wood to be used.

A. The best wood should be used to obtain the best results, and experience has shown that Southern Yellow Pine has given the best results.

B. That the wood used on any one extension should be of relatively the same hardness or density.

C. That the wood before treatment shall be, or be made to be, of the best condition as to porosity, so that it will take the treatment properly and retain the preservative best.

Discussion of this paper will be found on page 244.

OIL SPECIFICATION FOR CREOSOTED WOOD BLOCK.

By HERMANN VON SCHRENK, St. Louis, Mo.

The discussions concerning wood block paving specifications in the United States have, with few exceptions, dealt very largely up to the present time with specifications attempting to describe the kind of preservative oil to be used in the treatment of paving blocks. These discussions dealt with the relative advantages and disadvantages of straight coal-tar creosote, additions of refined coal tar to creosote, water-gas tars, etc. In spite of many arguments which have been made both for and against the various compounds to be used in a proper wood-preserving oil for paving blocks, a most unfortunate condition still exists regarding such oils; in fact, there are almost as many specifications today as there are cities using treated wood blocks. These specifications differ in their requirements as to whether the oil shall be a straight distillate creosote or a creosote and coal tar solution; they differ in details as to the proper specific gravities of the oils; the percentage of the various distillates; the admission or rejection of petroleum compounds, insoluble matter, etc., etc. The writer has for many years frequently questioned the practical value of many of these discussions, particularly the desirability of placing so much emphasis on what appeared to him to be more or less unimportant details with reference to the character of the oil used.

Some twenty years ago the creosote specifications promulgated for the treatment of telegraph poles, bridge materials, and cross ties were almost in the same chaotic condition. Arguments for and against specific quantities of naphthalene, tar acids, and oils of different gravities will be found in the engineering literature and reflected in the specifications then in use by various railroads, telegraph companies, state and government authorities. After a very comprehensive study of the specifications for wood-preserving oils in Europe, the writer was surprised to find that, while specifications differed in different European countries, excellent results in practice had been obtained in England, Germany, France and other European countries, in spite of the fact that they had all kinds of specifications, no two of them alike. All of the European specifications, however, distinctly specified that the oil should be a coal-tar creosote derived

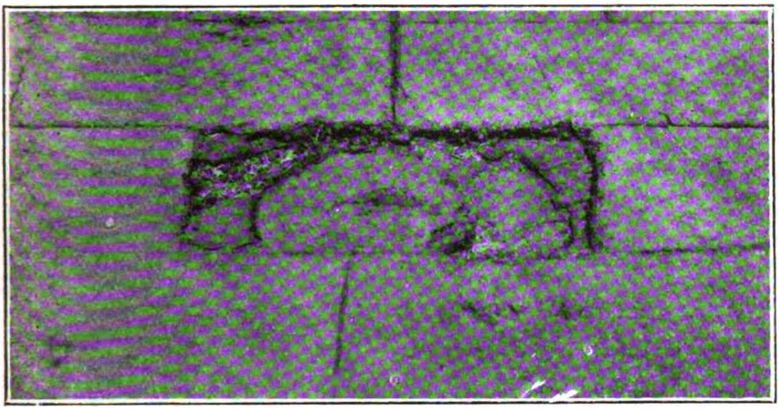


Fig. 1. Failure of block on Westminster Place, St. Louis. Treated with light creosote oil, 1903. Photographed June, 1915.

from strictly pure coal tar. European experience has shown that, when properly injected into sound seasoned timbers, in proper quantities, any good creosote derived from pure coal tar, protected such timbers for twenty-five or more years. The particular percentages of naphthalene, tar acids, etc., appeared to have very little to do with end results.

It has frequently been stated that for the treatment of paving blocks different factors control. What are these factors? At the present time the successful treatment of paving blocks may be divided into three parts: the character and quantity of the oil used, the manner of treatment, and the subsequent laying and maintenance of the pavement. The requirements for a good paving oil are that it should be antiseptic and should have some waterproofing qualities; that it must be stable so as to remain in the wood; that it must be capable of thoroly penetrating the timber.

In the case of the specifications for oil to be used in the treatment of timbers, ties, and telegraph poles, the final results obtained after many years of service, both here and abroad, have done more to standardize the oil specifications than any and all of the theoretical discussions which had preceded for forty or more years. A careful investigation of both successes and failures of creosoted ties, piling, poles, etc., showed the comparative unimportance of small details in a specification, and resulted in the adoption of a specification by

the American Railway Engineering Association some five years ago, which is simple and which has found practically universal acceptance on the part of the railroads and other large consumers of creosoted material.

The discussions as to paving block specifications have to date been very largely theoretical. Many streets, however, are now ten to fifteen years old, and some even older, and it appears possible to draw some interesting conclusions from the results so far obtained. During the past year the writer has made many detailed examinations of wood block pavements in various cities of the United States, which have given service of from ten to fifteen years and more. The results of these inspections clearly show that in the majority of cases, in fact practically universally, streets paved with creosoted yellow pine blocks had not only withstood the heaviest traffic successfully and resisted decay, but had shown probably a lower annual cost for maintenance than any other kind of pavement. There appears to be no longer any doubt but that properly creosoted yellow pine blocks, when carefully laid, give the best paved streets. The inspected pavements referred to have shown some failures, as was to have been expected. The most striking failures were doubtless due to improper laying, meaning by this improper construction of the foundations, the omission of proper expansion joints, failure to provide proper

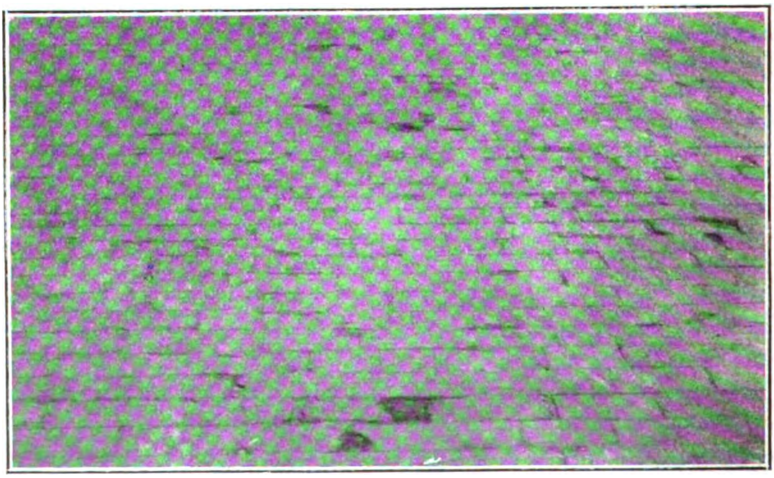


Fig. 2. Failure of blocks on Westminster Place, St. Louis. Treated with light creosote oil, 1903. Photographed June, 1915.

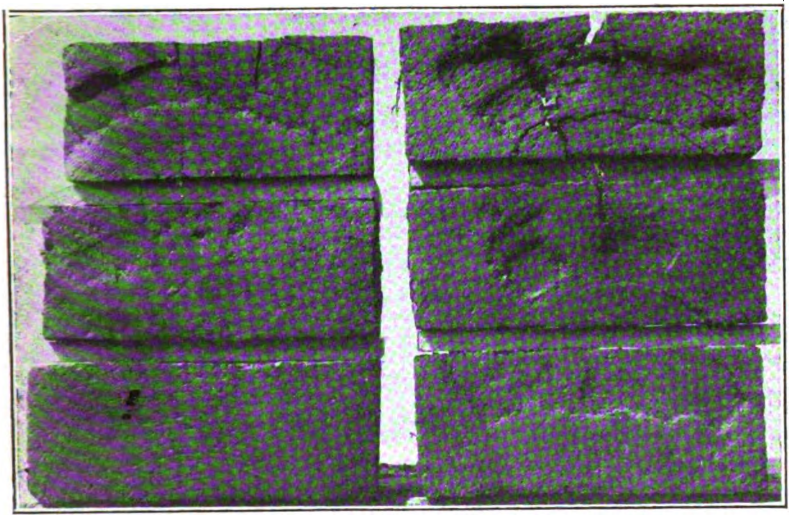


Fig. 3. Top view of Washington Boulevard pavement, St. Louis, treated with Kreodone, 1903, showing nature of failure.

drainage, etc. These omissions from standard practice were in the majority of instances so self-evident that there could be little argument about the cause for these failures. Failures due to decay of the blocks were far less numerous; in fact, of the streets examined, only a very small number showed any signs of failure due to decay, and even in the streets where failures did occur, the percentage was insignificant, the failures only resulting after a comparatively long period of years. It was believed, however, that some possible lessons as to further treatment could be obtained by careful investigation of the failures, with a view to correcting same in future practice.

The first failed blocks examined were from two streets in St. Louis, namely, Washington Avenue and Westminster Place. The wood blocks on Washington Avenue were treated with Kreodone oil in 1903. (The details of the specifications under which these blocks were treated will be found in the Appendix.) Some two years ago holes appeared in this street, scattered irregularly over the surface, some affecting only one block, others blocks in groups. A detailed examination showed that the wood fibers had given away, with consequent settling. Figures 1 and 2 show the appearance of some of these spots in the street, and figures 3 and 4 show the top

and bottom views of some of the blocks after removal. When sectioned thru the center, it was found that these blocks were decayed to various degrees in the sapwood (see figure 5). In not a single instance was any decayed heartwood found. The holes in Washington Avenue were temporarily filled with filler, and as the number of holes increased somewhat in 1915, a general overhauling was given the street, the old blocks were removed and replaced by new creosoted blocks. Incidentally, it was striking to note how perfect the repairing of a creosoted wood block street can be if done with care and attention. Today Washington Avenue looks just as it did when first laid, and the street is practically as good as new. The total number of blocks removed was probably between five and eight per cent.

On Westminster Place the blocks were treated with distillate creosote oil in 1903 and laid the latter part of that year. The specification called for a treatment with straight creosote oil. (The specification under which this treatment was conducted will be found in the Appendix.) As was the case on Washington Avenue, the blocks showed sinking from the top down (see figures 1 and 2), and when sectioned showed the same type of decay in the sap portion of the blocks, with a striking difference, to be noted hereafter (figures 6 and 7). The number of defective blocks in Westminster Place

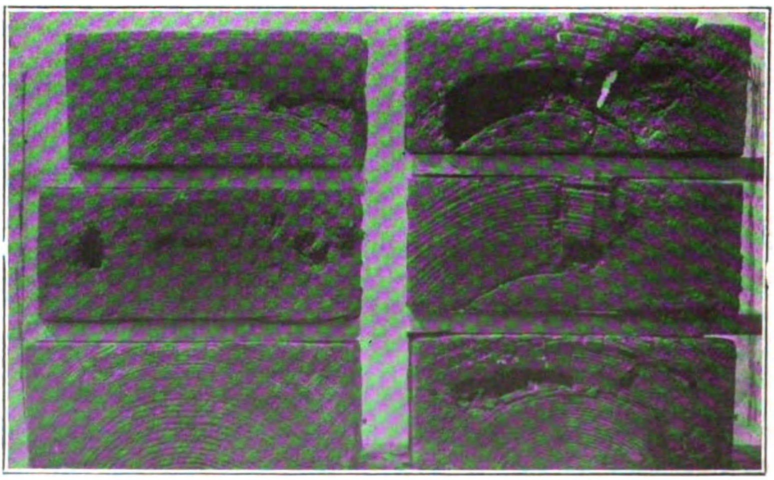


Fig. 4. Bottom view of same blocks.

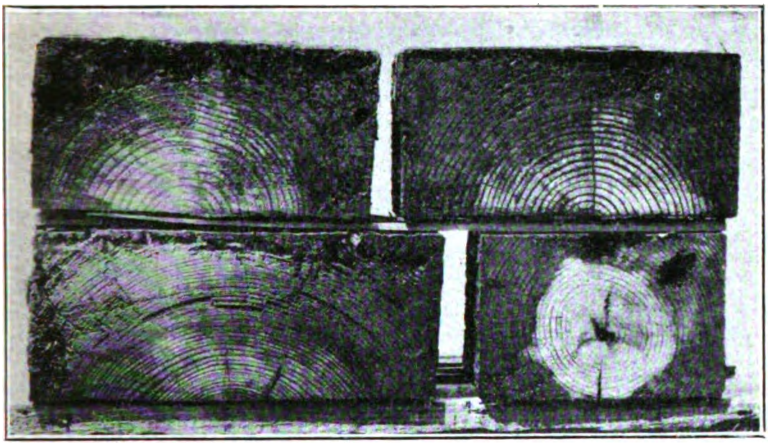


Fig. 5. Section thru middle of blocks from Washington Boulevard, St. Louis, showing nature of failure.

was extremely small; in fact, the writer was able to find on a distance consisting of several blocks, laid in 1903, not more than twenty or thirty blocks all told. These appeared singly and in groups, as was the case on Washington Avenue. Figure 1 shows a single defective block surrounded on all sides by blocks in perfect preservation.

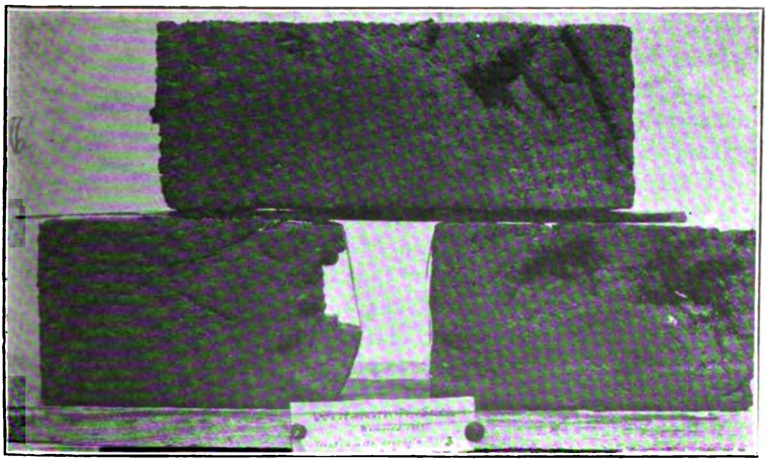


Fig. 6. Top view of blocks from Westminster Place, St. Louis, treated with creosote oil, 1903; removed 1915.

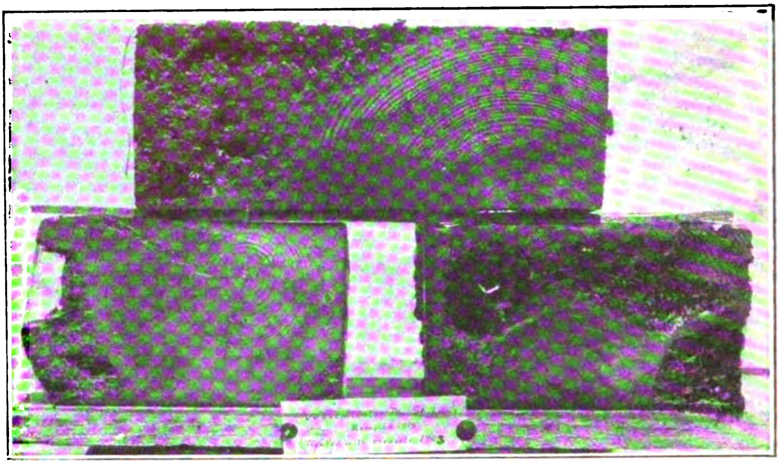


Fig. 7. Sections of paving blocks from Westminster Place, St. Louis, treated with creosote oil, 1903, showing nature of failure when blocks are cut thru the middle.

Figure 2 shows the worst spot in Westminster Place, photographed June, 1915. In both the blocks removed from Westminster Place and Washington Avenue, the inner sapwood was found in every stage of disintegration, from blocks just beginning to decay to such as had only a thin shell of creosoted wood on the outside. Not a single instance of heartwood decay was found.

In addition to removing many of the decayed blocks, a careful examination was made of the blocks which were still sound in the immediate vicinity of the decayed blocks. These showed a rather striking variability in the oil penetration. Some of the blocks were black thru and thru, others were but very imperfectly penetrated, and some looked as if they had no oil at all. The most instructive blocks were two which showed practically complete penetration of the heartwood, and only a very thin film of oil in the top layers of the sapwood. Figure 8 shows one of these blocks, in which it will be noted that the greater part of the sapwood has practically no oil in it at all. This untreated sapwood is showing signs of decay. Similar cases were found in the sound blocks taken from Westminster Place.

The oil was extracted from sound blocks taken from Washington Avenue and also from sound blocks taken from Westminster place.

In the following tables, the analyses of these two oils are given, and also the analyses (so far as it has been possible to get same) of the oil with which these blocks were treated in 1903:*

		Oil from blocks Washington Avenue	Oil from blocks Westminster Place
Specific gravity at 100° F.		1.086	1.069
Water		0.0	0.0
Distillation:	150° C.	...	0.3%
	200	...	2.0
	210	0.8%	0.7
	235	1.9	2.6
	250	1.4	3.8
	270	3.4	3.9
	315	13.0	19.4
	355	35.1	37.0
	Residue	34.0	30.2
Sp. Gr. 235-315 at 38° C.		1.032	1.032
Sp. Gr. residue at 25° C.		1.163	1.117

(Distillation according to standard method of the American Railway Engineering Association.)

	Original Oil Washington Avenue. Kreodone	Original Oil Westminster Place La. Oil
Water	Trace	5.0%
Distillation: 100° – 315° C.	43.0%	73.0%
Residue	57.0	22.0
Oils (below 207° C. and between) (235° C. and 315° C.)	30.0%	18.0%
Naphthalene (207° – 235° C.)	13.0%	55.0%

Note: Side neck distilling flask used, thermometer bulb at outlet.

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*The writer is much indebted to the Officials of the City of St. Louis; Mr. P. F. McCormick, Vice-President of the Parker-Washington Company; Mr. Robt. W. Barrell, of the St. Louis Sampling & Testing Laboratory; Officers of the Southern Creosoting Company, and Mr. F. P. Hamilton, Paving Engineer of the Southern Pine Association, for valuable assistance in getting records of the original treatments.

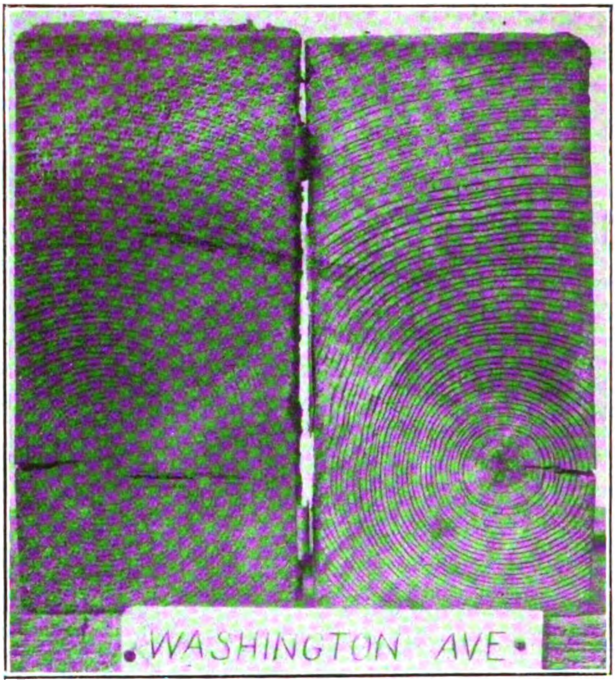


Fig. 8. Paving blocks from Washington Ave., St. Louis, showing heartwood penetration, with practically no oil in the sapwood. This untreated sapwood is showing signs of decay.

An examination of the table indicates that both the Kreodone oil, used in the treatment of Washington Avenue blocks, and the creosote oil, used in the treatment of Westminster Place, were probably oils having a very high percentage of low-boiling compounds. In other words, they were what are usually known as extremely light oils. This was particularly true of the oil which was used in the treatment of Westminster Place, which had approximately 55% distilling up to 235° C. The Kreodone oil, in addition to having a very high residue, showed distinct evidences of petroleum. No such indications were obtained for the oil extracted from blocks from Westminster Place. Unfortunately, a definite and detailed basis of comparison between the oil originally injected and that found in the blocks is not possible, owing to the lack of standard methods of analysis in 1903, making it somewhat difficult to draw accurate comparisons.

Without going into details, the conclusions drawn from the failure of the blocks on Washington Avenue are:

1. The blocks were treated with an insufficient amount of oil, as indicated by the fact that the amount now found in the blocks, after only twelve years, is about five pounds per cubic foot, when the original contract indicates that the blocks were supposed to have been treated with "twelve pounds per cubic foot and until the creosote oil shall have impregnated the entire thickness of the block, and to the satisfaction of the Board of Public Improvements and the Street Commissioner."

2. Many of the blocks received very poor treatment as to penetration. The comparatively high percentage of individual blocks which showed decayed sapwood, and no evidence whatever of sapwood penetration, indicates that the timber was probably full of water at the time of treatment, or that the oil quantity forced into the wood was entirely insufficient to give the necessary sap penetration.

3. The oil used probably had considerable percentages of petroleum compounds, and a portion of the failure of the sapwood to resist decay is undoubtedly due to the presence of an oil not strictly of

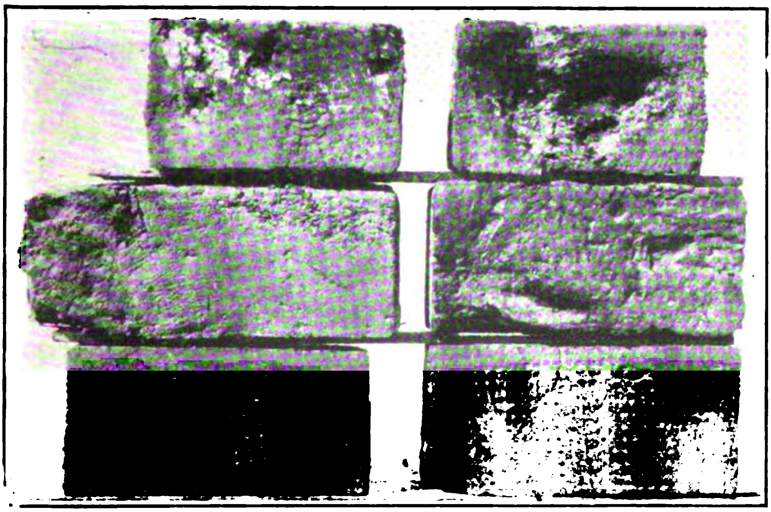


Fig. 9. Top view of blocks from Parkwood Avenue, Todelo, O., treated with Kreodone oil, 1901.

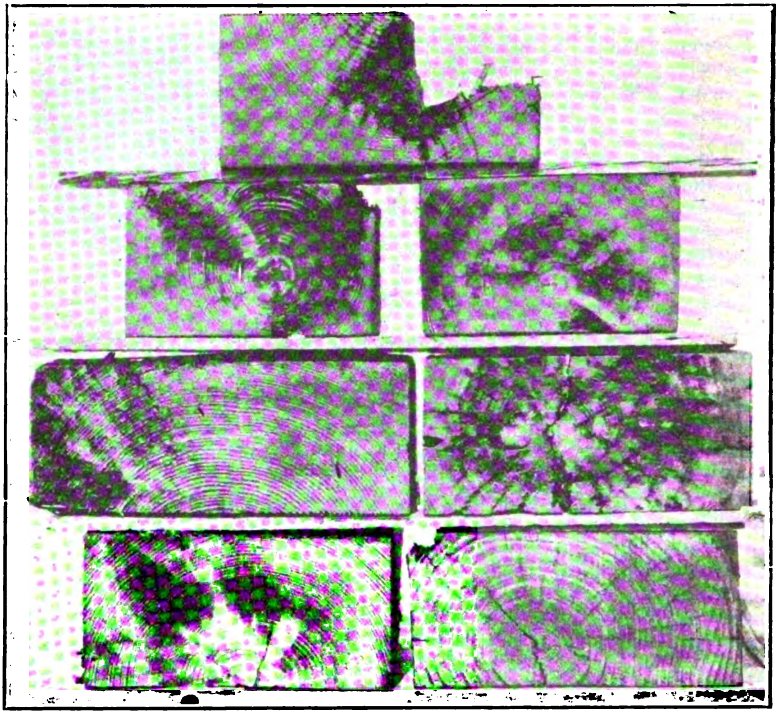


Fig. 10. The same blocks showing sections thru the middle.

coal-tar origin. This is very clearly indicated by figure 5, showing decay of the blocks in what was obviously treated sapwood.

It is extremely probable that improper treatment and improper oil both contributed, in the case of Washington Avenue, to the failure of the comparatively high percentage of blocks in the street.

The failure of the blocks in the case of Westminster Place is probably due to the following causes:

1. Insufficient absorption on the part of a number of blocks, due to high water content in the sapwood.

2. The use of very high naphthalene-containing oil, a large percentage of which has by this time disappeared from the blocks.

3. The injection of too low a quantity of oil per cubic foot, namely, twelve pounds.

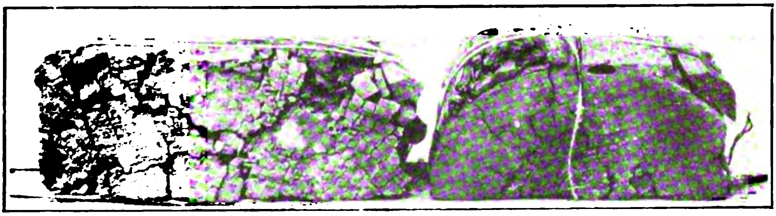


Fig. 11. Paving blocks from Parkwood Avenue, Toledo, O., treated with Creo-Resinate mixture in 1909. Photographed 1915.

None of the Westminster blocks showed decay in any part of the sapwood still containing creosote oil, indicating clearly that the straight coal-tar product, even of the low-boiling character of oil obviously used in the treatment of these blocks, afforded protection for a certain period of time, which cannot be said for the oil used in the treatment of the blocks on Washington Avenue.

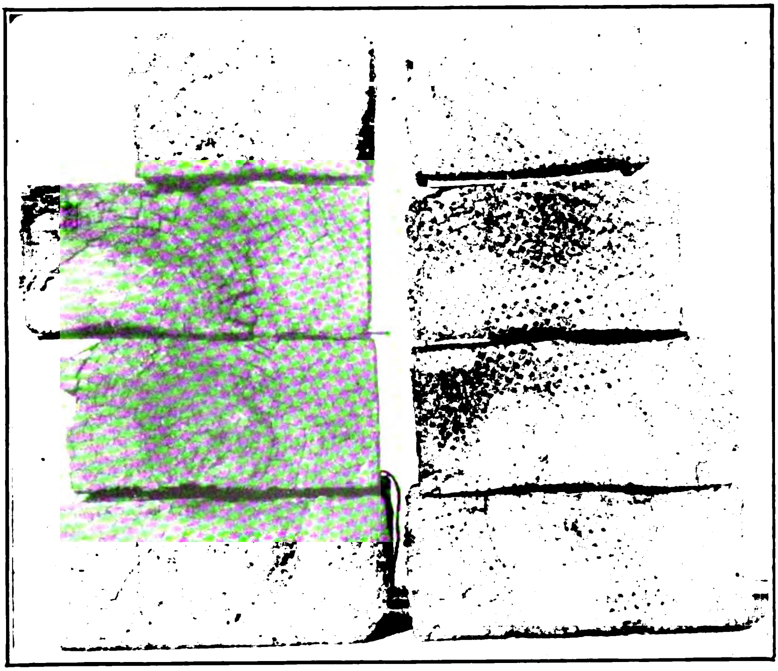


Fig. 12. Paving blocks from Summit Avenue, Toledo, O., treated with Kreodone paving oil, laid in 1905.

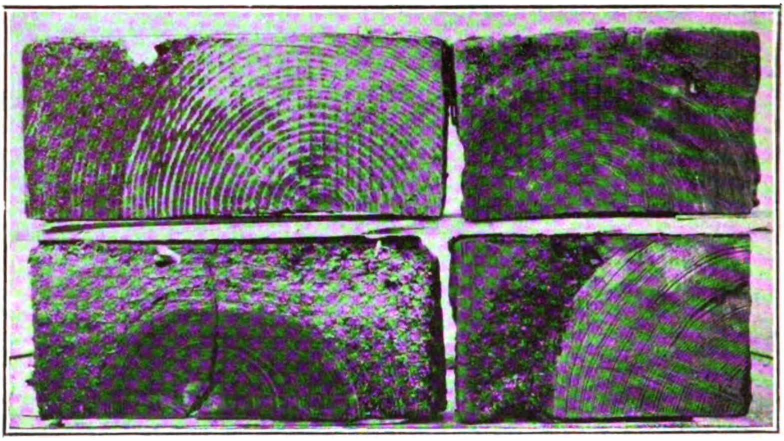


Fig. 13. Summit Avenue blocks, sectioned thru the middle, showing nature of failure.

Examinations similar to those recorded for the two St. Louis streets were made in Toledo.* Four streets were found showing defective blocks, namely, Parkwood Avenue, from Winthrop to Delaware, designated hereinafter as Parkwood Avenue No. 2; Parkwood Avenue, from Monroe to Bancroft, designated as Parkwood Avenue No. 1; Robinwood Avenue, from Monroe to Bancroft, and Summit Street.

The defective blocks in these streets were comparatively few in number, altho there were some indications that the numbers might increase during the coming years. The character of the failures was very much the same as that described for the St. Louis streets.

Parkwood Avenue No. 1 was laid in 1901 and was treated with Kreodone paving oil. Parkwood Avenue No. 2 was laid in 1909 and was treated with Creo-Resinate mixture. Robinwood Avenue was laid in 1905 and was treated with Kreodone paving oil. Summit Street was laid in 1905 and treated with Kreodone paving oil. (The detailed specifications for these four treatments will be found in the Appendix.) Figures 9 to 15 show the appearance of some of the failed and some of the sound blocks, both before and after sectioning, from these four streets.

*The writer is indebted for assistance in obtaining data from Toledo to the Street Department of the City of Toledo, and to Messrs. Jennison and Wright.

Oil extractions were made from blocks from several of the streets, the results being indicated in the following table:

		Oil from blocks Parkwood Ave. No. 1	Oil from blocks Parkwood Ave. No. 2	Oil from blocks Summit Ave.
Sp. Gr. at 100° F.		1.060	1.119	1.084
Water		0.0%	0.0%	0.0%
Distillation:	150°C.	0.5%	....	....
	200	2.8	2.6%	4.6%
	210	1.6	0.9	0.7
	235	7.1	2.2	3.0
	250	6.3	1.9	6.3
	270	17.6	2.8	19.7
	315	22.6	10.3	17.0
	355	26.0	35.3	20.3
	Res.	15.2	43.6	31.1
Sp. Gr. 235-315 at 38° C.		1.046	0.988	1.038
Sp. Gr. residue at 25° C.		1.191	1.158	1.201
Sp. Gr. 315-355 at 38° C.		1.088	....	....

The results of the examination of the Toledo blocks indicate even more strongly than did those found in the St. Louis streets that the two factors of the poor quality of oil, meaning by this oil with

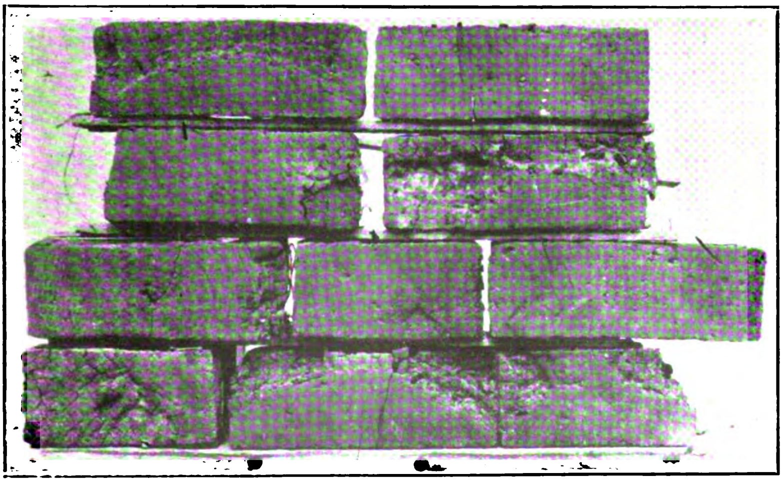


Fig. 14. Paving blocks from Robinwood Avenue, Toledo, O., treated with Kreodone paving oil, laid in 1905

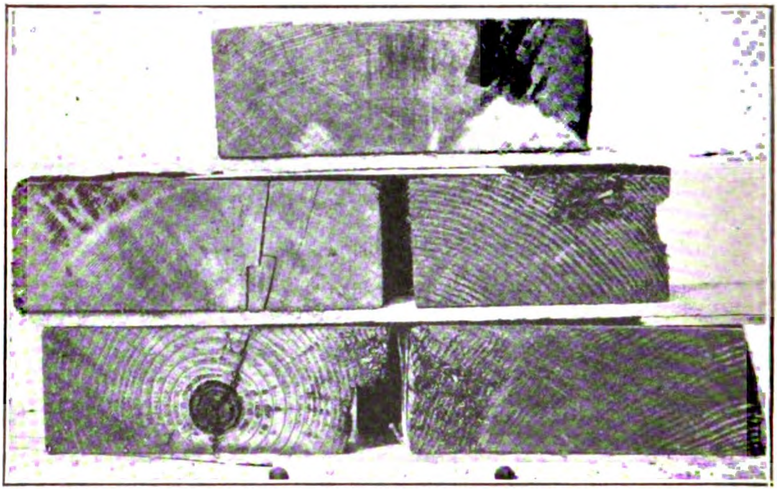


Fig. 15. Robinwood Avenue blocks, sectioned thru middle, showing nature of failure.

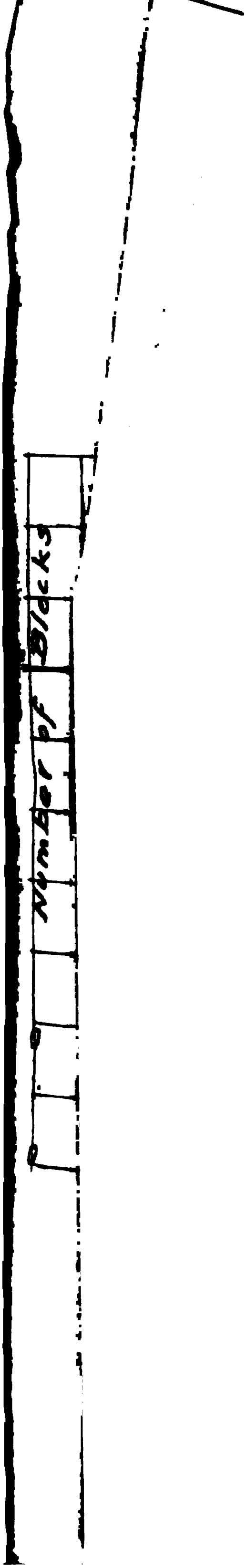
petroleum additions, combined with the poor injection processes, were in all probability responsible for the failures.

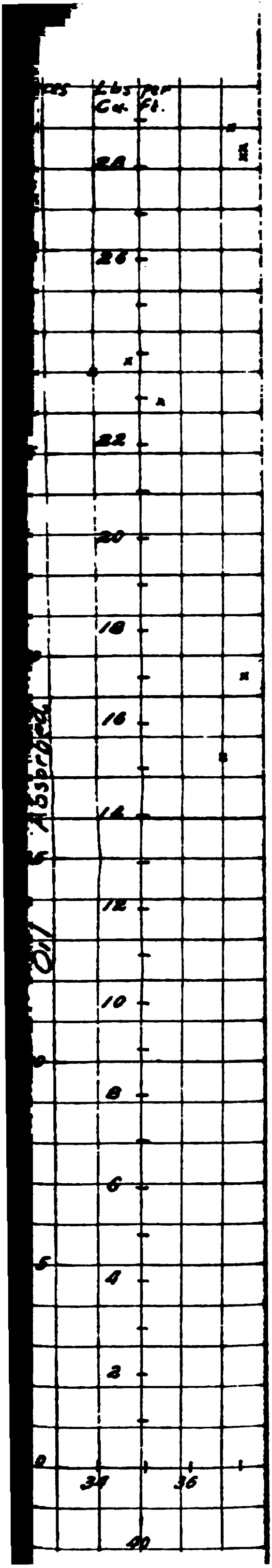
A third case of marked failures of blocks was found in Charleston, S. C. Figures 5, 16 and 17 show two views of these blocks.

An examination of the oil extracted from these blocks shows the following results:

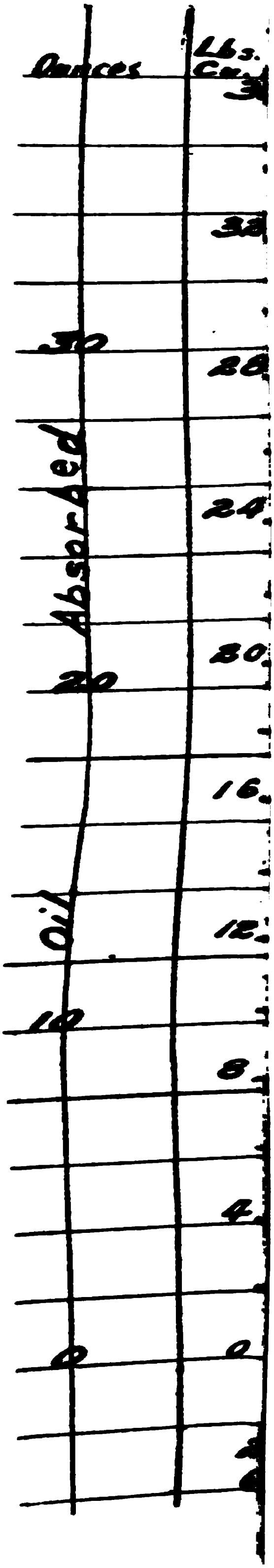
Specific gravity at 100° F.		= 1.142
Water		0.0%
Distillation:		
210° C	1.90%	
235	4.22	
270	5.60	
315	10.90	
355	19.69	
Residue	56.30	
Sp. Gr. 235-315 at 60° C.		= 1.011
Sp. Gr. residue at 25° C.		= 1.231
Sulphonation 250-315		= 14%

It appears from this analysis that the oil originally used was almost a straight water-gas oil.


Number of Blocks



Lbs per Cu. Ft.
28
26
22
20
18
16
14
12
10
8
6
4
2
0
34
36
40
Oil Absorbed


Ounces
Lbs.
Oil Absorbed
30
20
10
0
32
28
24
20
16
12
8
4
0

The penetration in these blocks was extremely superficial, some of the blocks having hardly 1/16-inch penetration. The surprising fact in this case was that the blocks served as long as they did.

The conclusions drawn from all of these examinations being that the most important factor responsible for these failures was the lack of proper sap penetration and that in several instances decay was undoubtedly hastened by the use of oil not a straight coal-tar product.

This brings up the question of penetration. It is almost axiomatic that efficient penetration will depend on the condition of the timber, meaning thereby its water content and soundness; on the character of the wood treated; on the volume of the oil injected, and to a slight degree on the character of the oil used, meaning thereby the percentage of insoluble matter; and on the temperature employed during the treating process. Many complaints have been received from time to time during late years that blocks, after delivery on the street, showed white wood. Many city specifications contain clauses requiring that "all blocks shall be penetrated thru and thru by the preservative," to which is frequently added the interesting clause "and to the satisfaction of the city engineer." The investigations made by the writer during a good many years, dealing with the absorption of coal-tar creosote by different classes of wood, have clearly shown that absorption and penetration are determined by two factors, (1) the individual characteristic of the piece of wood to be injected, meaning thereby the natural density and the per-

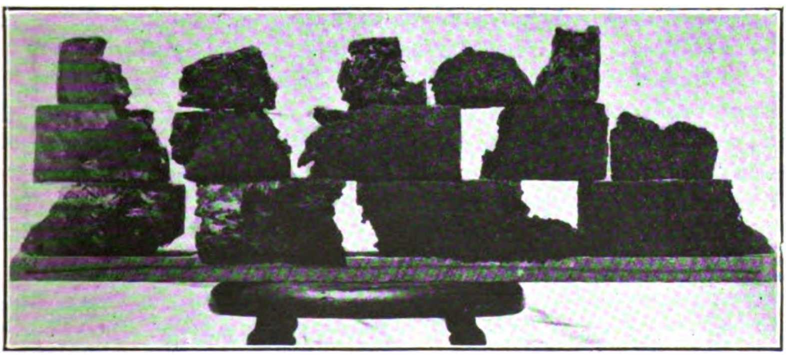


Fig. 16. Top view of paving blocks from Charleston, S. C., removed because of failure. Treated 1912; removed 1915.

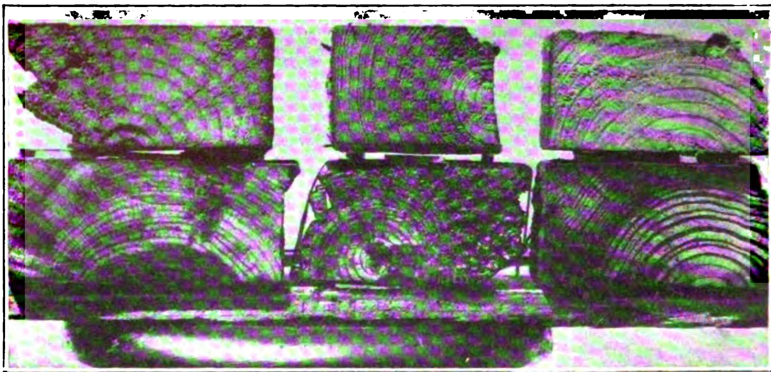


Fig. 17. Sections thru blocks from Charleston, S. C.

centage of water contained in the individual stick, and (2) the volume of the oil injected. The densest piece will absorb the least quantity of oil, the most porous piece the highest quantity, when both are treated in the same charge under the same conditions. Pieces with high water content will absorb less oil than those with low water content. A charge into which an average of twenty pounds of creosote is injected will show better penetration than one in which only ten pounds per cubic foot are injected.

In order to determine the law of penetration for paving blocks, a number of experimental runs with paving blocks were made, using both a solution of coal tar and creosote oil and a straight creosote oil. Five different tests were conducted, each at a different treating plant. In each case 100 paving blocks, picked at random, were weighed individually on a postal scale before treatment, and each block was carefully numbered for identification. These 100 blocks were treated in a regular charge, and immediately after the treatment the blocks were weighed again, to determine the amount of oil absorbed. The results of these five tests have been plotted graphically in diagrams Nos. 1 to 10. It will be noted that there are two diagrams for each test, one showing the variation in absorption in 100 blocks, without relation to the weight of the individual blocks before treatment. At the bottom of the diagram two scales are given, the lower one showing the number of ounces absorbed, the upper showing the number of pounds per cubic foot. Diagrams 1, 3, 5, 7 and 9 show this method of plotting. The individual crosses show the number of paving blocks which absorbed the

quantity of oil indicated by the figures at the bottom. A study of these five charts will show that no matter what the oil used, no matter at what plant the blocks were treated, and irrespective of the condition of the timber at the time of treatment, there is a small number of blocks in each case which absorbed a comparatively small

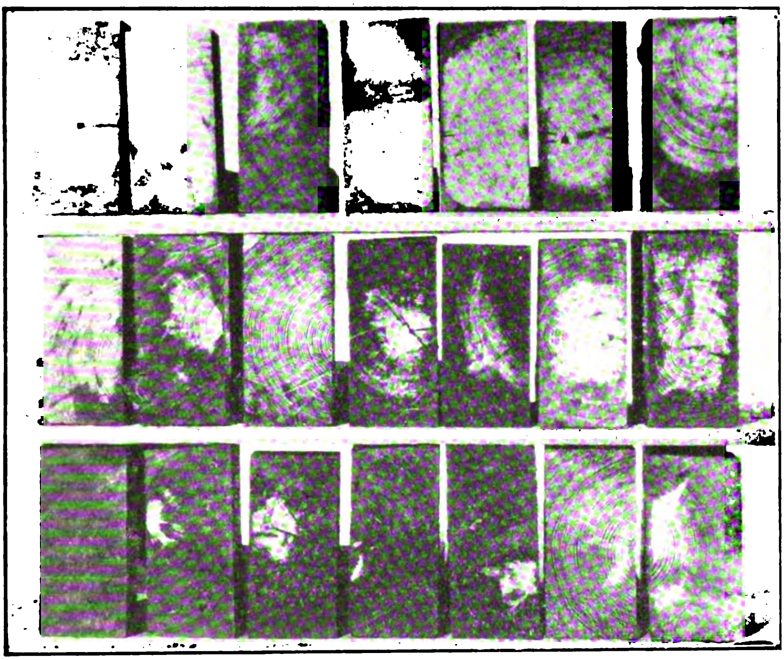


Fig. 18. Yellow pine paving blocks treated with coal-tar-creosote solution, sectioned to show penetration.

Ounces of oil absorbed per block.

Top Row	3	6	7	8	8	9	10
Middle row	16	16	16	16	16	16	16
Bottom row	26	24	23	23	23	22	22

Analysis of Oil.

Sample Number 3026

Specific gravity at 38°C.=1.110

Distillation:	200°C.	2.0%
	210	3.7
	235	22.2
	270	36.7
	315	45.2
	355	57.7
	Residue	42.3

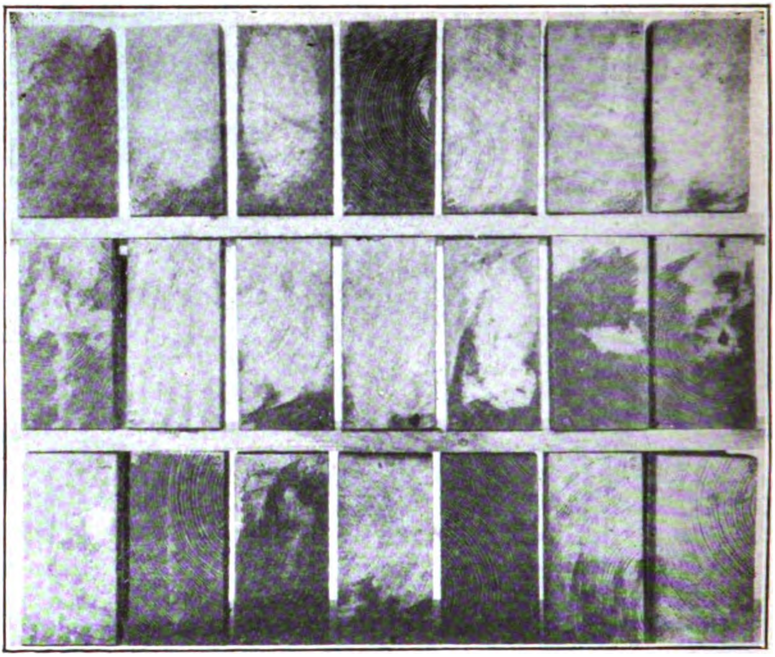


Fig. 19. Southern yellow pine paving blocks treated with coal-tar-creosote solution, sectioned to show penetration.

Ounces of oil absorbed per block.

Top row	3	3	6	1	4	8	10
Middle row	17	17	17	17	16	17	17
Bottom row	22	27	20	23	39	29	28

Analysis of Oil.

Specific gravity at 38°C.=1.110

Distillation:	210°C.	2.5%
	235	16.6
	270	33.6
	315	44.7
	355	57.4
	Residue	42.6
	Free carbon	3.3%

quantity of oil, and similarly a small number of blocks that absorbed a comparatively large quantity of oil, and that between these two there were various degrees of absorption, but that the largest number of blocks invariably falls near the point intended to give the average absorption. Diagrams 2, 4, 6, 8 and 10 show the same data, and in this case the lines at the bottom, showing both ounces

and pounds per cubic foot, indicate the weight of the individual blocks before treatment, while the upper figures, showing both ounces and pounds per cubic foot, indicate the number of ounces and pounds per cubic foot absorbed. In other words, these are correlation charts. Here again it will be noted in all five of the charts that irrespective

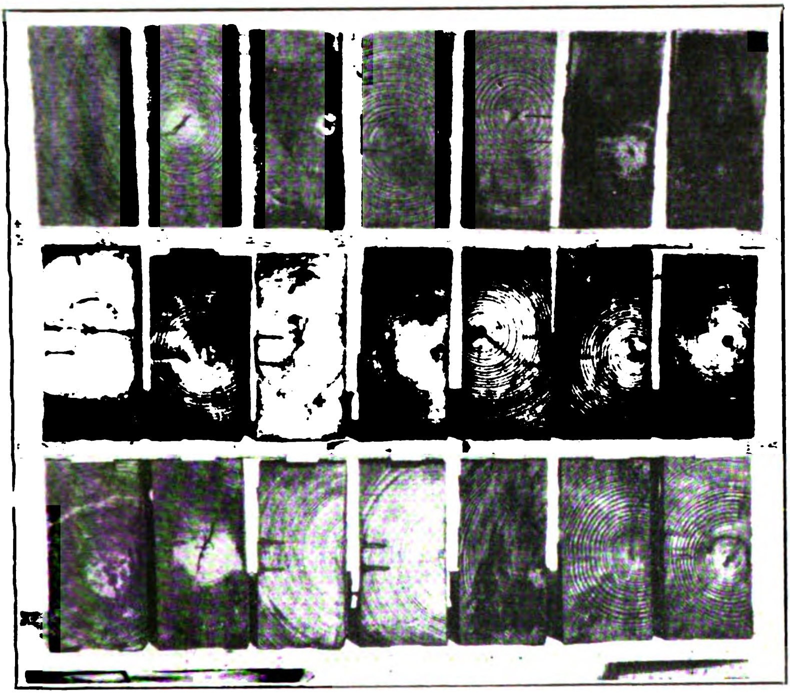


Fig. 20. Yellow pine paving blocks treated with coal-tar-creosote solution, sectioned to show penetration.

Ounces of oil absorbed per block.

Top row	22	21	19	19	19	19	18
Middle row	10	10	10	10	10	9	9
Bottom row	9	7	6	6	2	1	0

Analysis of Oil.

Sample Number 2995

Specific gravity at 38°C.=1.100

Distillation:	210°C.	2.5%
	235	6.5
	270	27.0
	315	41.2
	355	55.8
	Residue	44.2

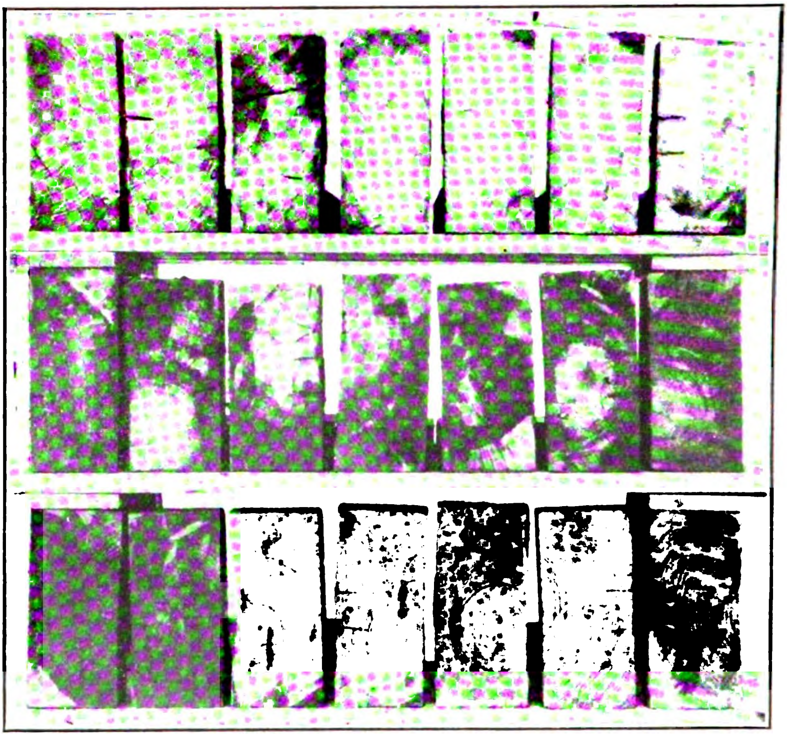


Fig. 21. Yellow pine paving blocks treated with heavy distillate creosote oil, sectioned to show penetration.

Ounces of oil absorbed per block.

Top row	1	2	9	9	11	12	14
Middle row	17	20	21	21	22	22	22
Bottom row	32	32	32	33	33	33	34

Analysis of Oil.

Sample Number 3031
Specific gravity at 38°C.=1.100

Distillation:	200°C.	1.7%
	210	2.1
	235	3.8
	270	17.5
	315	37.8
	355	65.7
	Residue	34.3

of the treatment oil used and the kind of timber, there is a definite relationship between the weight before treatment and the amount of oil absorbed. A line can be drawn in every one of these cases,

beginning at the upper left-hand side of the chart and running down to the lower right-hand corner, indicating that the denser and heavier the block, the smaller will be the quantity of oil which it will absorb.

It is a rather striking thing that this correlation is true not only for the absorption of paving blocks, but holds equally well for all classes of timber, irrespective of species. It is true also for all measurements of things belonging to the organic kingdom. It is typical of the variability of natural things. The variation is something fundamentally inherent in the wood, and will be found in all classes of timber and in all treatments. That there is an important relation between the amount of oil absorbed per block and the pene-

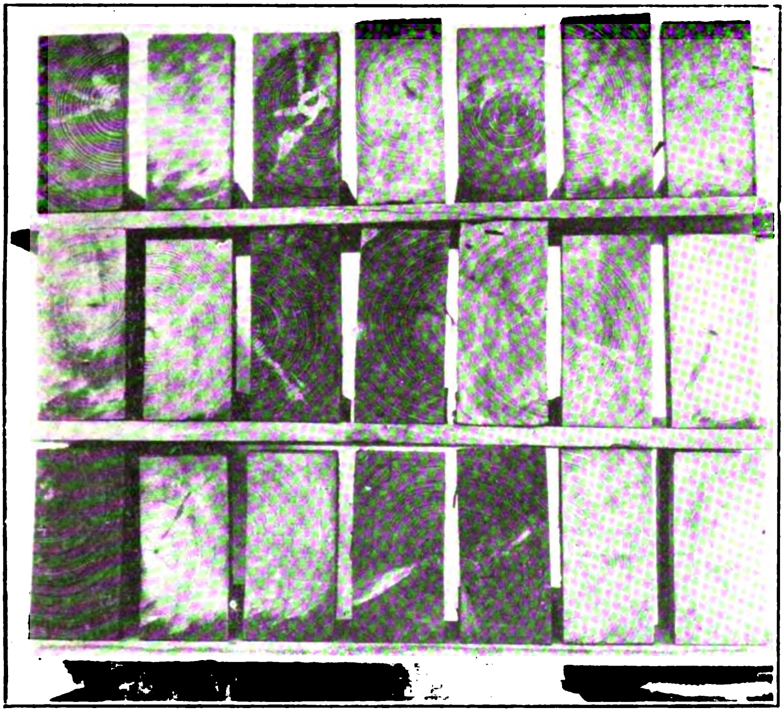


Fig. 22. Southern yellow pine paving blocks treated with English distillate creosote oil, sectioned to show penetration.

Ounces of oil absorbed per block.

Top row	24	23	22	20	19	18	15
Middle row	14	13	12	12	12	11	10
Bottom row	10	9	9	8	7	7	6

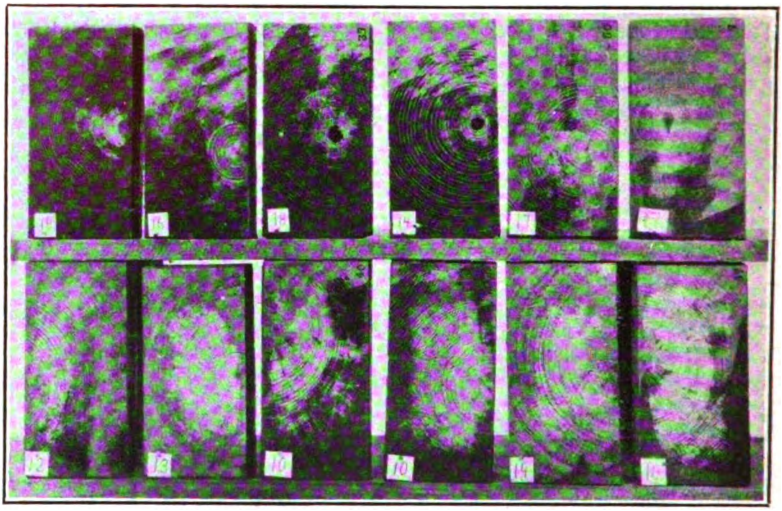


Fig. 23. Yellow pine paving blocks treated with coal-tar-creosote solution, sectioned to show penetration. The figures denote the absorption of oil in ounces.

tration is of course obvious. The blocks which absorbed only two ounces will show a far different penetration than those which absorbed thirty ounces. In figures 18 to 23 are shown photographs of these blocks sectioned thru the middle, each treatment of the test being represented. The blocks are arranged in rows of seven, one row containing seven blocks showing the lowest absorption, the next row containing seven showing the average absorption, and the third seven showing the highest absorption. It is an interesting fact to note in this connection that, while the absorption of some of these blocks is small and they have a correspondingly small penetration, there appears to be compensation in the fact that the densest blocks which absorbed the least oil also require the least oil to preserve them. In all of the streets examined a considerable number of blocks were found in which considerable portions of the heartwood were not penetrated, but in every case the sapwood was thoroly penetrated (Fig. 24 to 28). Our tests were, as has already been stated, undertaken to determine what penetration it was possible to get in paving blocks, due to the oft repeated requirements that all blocks must be penetrated thru and thru. The results of these tests clearly show that with the usual oil quantity specified, that is, about fifteen pounds

per cubic foot, it is not possible to penetrate all blocks so that they are black thru and thru, but that, owing to the natural variability of the wood, there will be some blocks which have less than the average quantity and some more than the average quantity. In all cases, however, a thoro sap penetration is obtainable. Those blocks having white heartwood, but with all the sapwood thoroly penetrated, will probably last as long as those which are completely penetrated, because, as has been mentioned, the densest blocks which absorb the least oil have a natural resisting power, and the chances of their lasting are probably equally as good as those which are penetrated more thoroly, provided that the sapwood is always thoroly penetrated.

Curiously enough, the blocks which showed the poorest penetration were treated with heavy distillate creosote oil. Figure 29-A shows two blocks treated with this oil at one plant and figure 29-B two blocks taken from the street at Saginaw, Mich., treated with the same kind of oil at another plant. In both cases it will be observed that considerable portions of the sapwood are perfectly white, with no oil in them. In other words, it shows exactly the condition that existed in the blocks above described that had failed by reason of decayed sapwood. It would be absurd to maintain that this failure to penetrate is to be ascribed to the distillate oil used, because it is perfectly obvious that this failure to penetrate the sapwood was due to the high water percentage of these particular blocks, and not to the oil. This case is simply presented to show the absurdity of

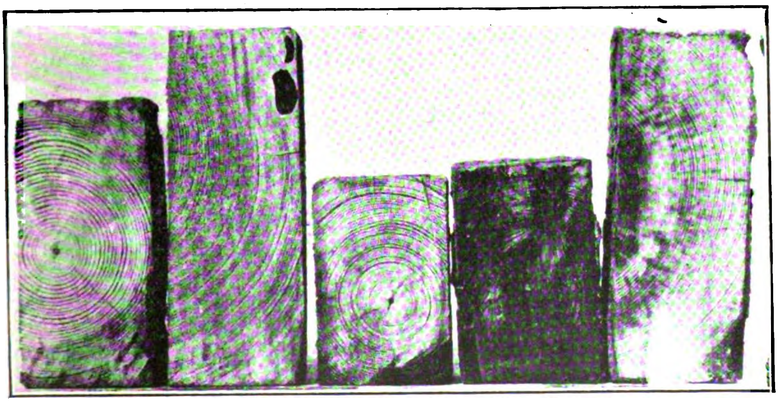


Fig. 24. Sound blocks from Westminster Place, St. Louis, treated in 1904, removed in 1915.

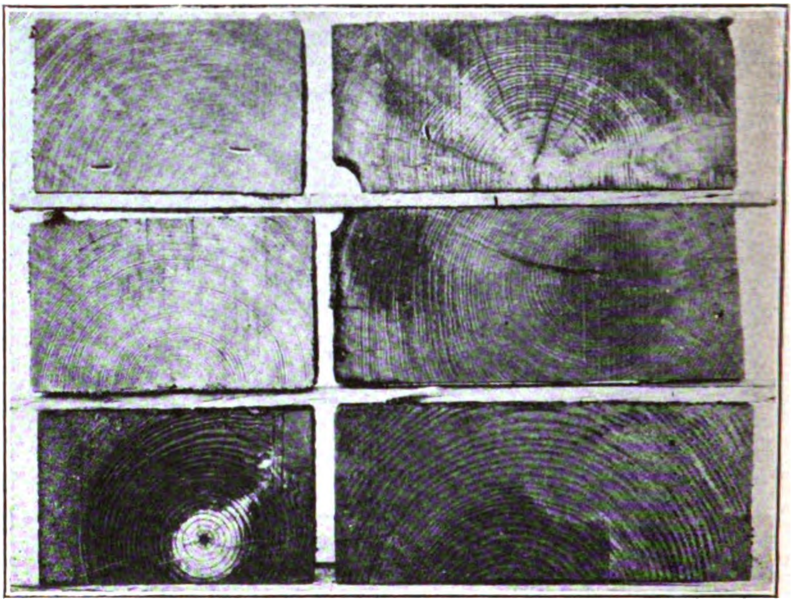


Fig. 25. Sound blocks from Summit Avenue, Toledo, treated in 1905, removed in 1915.

doubtless well-meaning arguments both for and against distillate creosote oil and a coal-tar solution, that one or the other has superior penetrating powers. This kind of argument has little scientific value, and it has unfortunately come largely from those interested in the use of straight creosote oil. It is high time that this type of discussion be relegated to oblivion. As was shown in the present instance, the penetration is not dependent upon the oil to anywhere near the extent that it is upon the condition of the timber and the manner in which the oil is injected into the timber.

The lesson to be learned from the experiments just described and from examinations of old paving blocks which have been in the street many years, and which are still perfectly sound, indicates that absolute penetration for every block can not be obtained. It also shows that this is absolutely unnecessary. It shows strikingly, however, that perfect sap penetration is absolutely essential. This can easily be obtained, provided sufficient oil quantities are used and provided the process of injection is properly conducted. There is

no excuse whatever for shipping paving blocks from any creosoting plants, no matter what the oil used may be, in which any number of paving blocks are included which show only partial sap penetration. It makes no difference whether this is with a straight creosote distillate oil or with a reasonable coal tar and creosote solution. There are plenty of instances, both in the case of paving blocks and in the case of railroad ties where timbers have lasted for years and years, with only a very small penetration on the outside, but in all these cases the sapwood had been thoroly penetrated.

Using the foregoing investigation as a basis, the writer has insisted that the first requirement for a specification for the treatment of paving blocks is that a pure coal-tar compound be used in treatment. It is maintained that it makes little difference whether this is a heavy distillate oil or whether it is a creosote and coal-tar solution, in which the percentage of coal-tar is restricted to a reasonable quantity. The writer has little sympathy with the hair-splitting discussions as to the advantages or disadvantages of one or the other. Both are efficient when properly used.

There has been much discussion of late as to the difference in the so-called bleeding when one or the other compounds is employed,

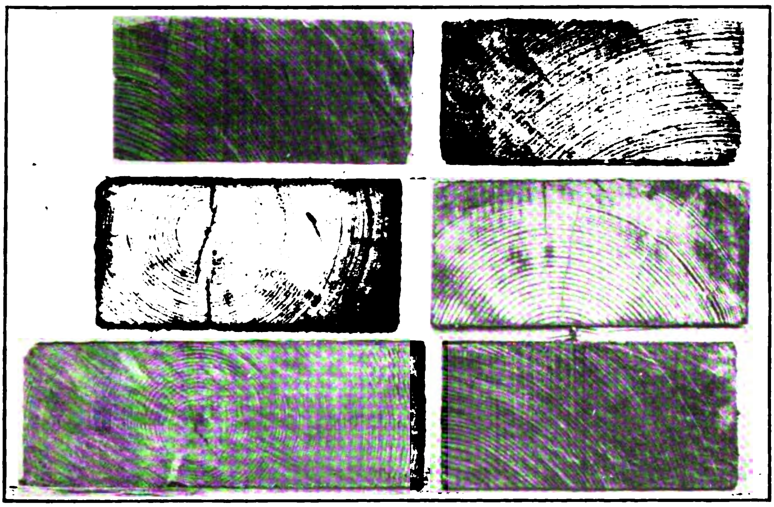


Fig. 26. Sound blocks from Robinwood Avenue, Toledo, treated in 1905, removed in 1915.

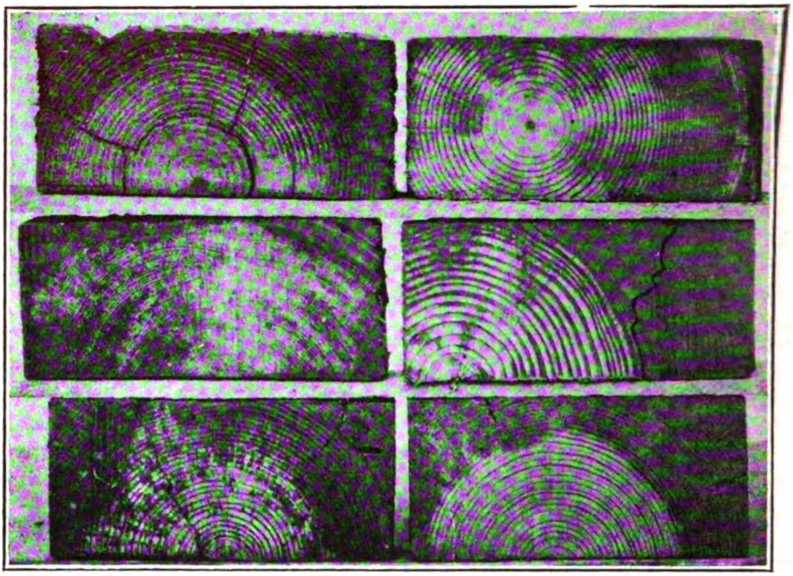


Fig. 27. Sound blocks from Parkwood Avenue, Toledo, treated in 1909, removed in 1915.

but from what the writer has been able to observe, both in the eastern and western states, he has no hesitation in saying that both blocks bleed, whether treated with straight creosote or a coal-tar and creosote solution, provided the method of injection has been faulty. To the writer, bleeding of both distillate oil and coal-tar and creosote solution is objectionable, and is doubtless objectionable to the citizens of our communities. Why, therefore, continuously argue for one or the other as if there were any fundamental differences? The coal-tar oils which will be used for treatment of paving blocks will depend upon availability and cost. Both creosote oil and creosote oil mixed with coal-tar are available, and both will be and should be used. The excessive addition of coal tar to creosote oil has been justly criticised, but on the other hand it is becoming more and more evident that a reasonable addition of coal-tar to creosote is good practice.

The writer realizes the difficulty of writing a specification which will be satisfactory to all concerned. The Committee on Standards of this Society is therefore to be congratulated on the successful

formulation of a specification which will admit any high-grade coal-tar product, that is, either a heavy distillate oil or a coal-tar-creosote solution containing a limited amount of coal tar. The term "coal-tar-creosote solution" as used herein was adopted this year by the American Railway Engineering Association. It is strongly urged that the Society at its deliberations tomorrow adopt this specification prepared by the committee. One standard is always desirable, and while this specification may not strictly meet all views (I would like some slight changes), it is so far in advance of anything which the industry has had that it should be generously supported.

In conclusion the writer wishes once more to emphasize that the most important part in the present consideration of paving block specifications is not the oil specification. This is a very vital part, and a straight coal-tar product free from the admixture of other substances should be specified, and the specification cannot be too

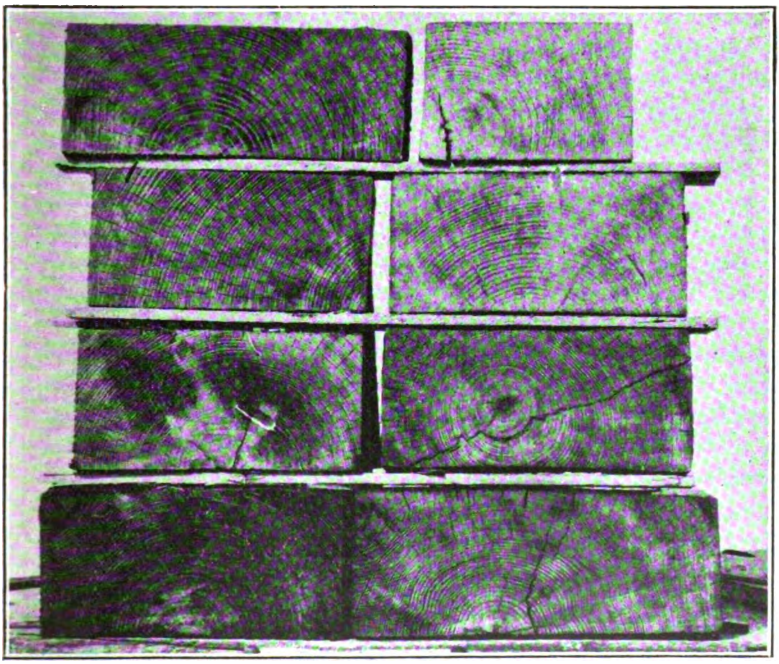


Fig. 28. Sound blocks from Parkwood Avenue, Toledo, treated in 1901, removed in 1915.

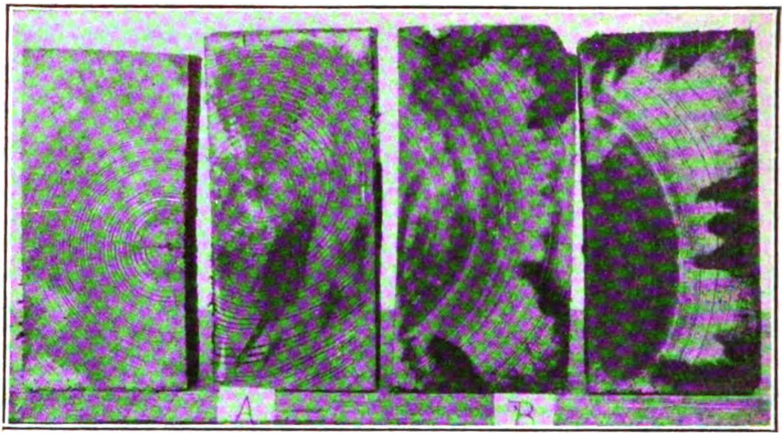


Fig. 29. Paving blocks treated with heavy distillate creosote oil, showing very poor sap penetration. (A) Recently treated blocks. (B) Blocks from street in Saginaw, Mich.

rigid to accomplish this purpose. There are other factors equally as important, however, as the oil specifications, and these are chiefly the specification dealing with the manner in which the oil is to be injected into the timber and the quantity to be used, and the subsequent methods used in laying and caring for the blocks.

The treatment discussion is not a part of my subject, but I would urge a vigorous endorsement of the American Society of Municipal Improvements' report on treatment. Treat preferably partly dry timber and steam same to reduce the gaseous contents of the wood cells. If the timber is green, steam it longer and then give a sufficient time of pressure and a sufficient oil quantity, so as to insure absolute sap penetration. If any lesson can be drawn from the results of the failures herein described, they certainly indicate that, while emphasis should be placed on the oil used, just as much attention should be given to the manner in which the good preservative specified is applied.

Appendix.

Extracts from Specifications for treatment of the St. Louis and Toledo Wood-Block Pavements.

Washington Ave. and Westminster Pl., St. Louis, Mo. 1903.

After the blocks have been inspected and found satisfactory, they shall be placed in an air-tight chamber, where, by means of super-

heated steam and the use of a vacuum pump, all sap in the blocks shall be vaporized and the moisture in them removed. When the blocks are thoroly dry, and while the cylinder is under vacuum of fifteen to twenty inches of mercury, heavy creosote oil, of the grades known as Kreodone, or Republic Creosote Paving Oil, especially prepared for paving purposes, shall be admitted into the cylinder and pressure added until the pressure in the cylinder shall be at least sixty pounds to the square inch. The blocks shall remain in the cylinder until they have absorbed twelve pounds of oil per cubic foot of timber and until the creosote oil shall have impregnated the timber thru the entire thickness of the block, and to the satisfaction of the Board of Public Improvements and the Street Commissioner.

Parkwood Avenue No. 1, Toledo, Ohio. 1901.

After the blocks have been inspected and found saticfactory, they shall be placed in an air-tight chamber, where, by means of superheated steam and the use of a vacuum pump, all sap in the blocks shall be vaporized and the moisture in them removed. When the blocks are thoroly dry and while the cylinder is under vacuum of fifteen or twenty inches of mercury, Kreodone Paving Oil shall be admitted to the cylinder and pressure added until the blocks have absorbed ten pounds of oil per cubic foot of timber, and until the Kreodone Paving Oil shall have impregnated the timber thru the entire thickness of the block, and to the satisfaction of the City Civil Engineer.

Robinwood Avenue, Toledo, O. 1905.

Blocks shall in all respects be satisfactory to the Engineer, and shall have been prepared by the "Kreodone Creosoting" process. After the blocks have been inspected and found satisfactory, they shall be placed in an air-tight chamber, where, by means of superheated steam and the use of a vacuum pump, all sap in the blocks shall be vaporized and the moisture in them removed. When the blocks are thoroly dry and while the cylinder is under vacuum of fifteen or twenty inches of mercury, Kreodone Paving Oil shall be admitted to the cylinder and pressure added until the blocks have absorbed sixteen pounds of oil per cubic foot of timber, and until the oil shall have impregnated the timber thru the entire thickness of the block and to the satisfaction of the Engineer.

Summit Avenue, Toledo, O. 1905.

After the blocks have been inspected and found satisfactory, they shall be placed in an air-tight chamber, where, by means of superheated steam and the use of a vacuum pump, all sap in the blocks shall be vaporized and the moisture in them removed. When the blocks are thoroly dry and while the cylinder is under vacuum of at least twenty inches of mercury, Kreodone Creosote Oil, or the creosote mixture used in the Creo-Resinate process, shall be admitted to the cylinder and pressure added until the blocks have absorbed sixteen pounds of oil per cubic foot of timber, and until the Kreodone Creosote Oil, or the creosote mixture used in the Creo-Resinate process shall have impregnated the timber thru the entire thickness of the block, and to the satisfaction of the engineer.

Parkwood Avenue No. 2, Toledo, O., 1909.

Treatment: The blocks are to be treated thruout with an antiseptic and waterproof mixture, 75 per cent of which shall be creosote or the heavy, dead oil of coal tar conforming to the specifications hereinafter set forth, and 25 per cent of which shall be resin conforming to the specifications hereinafter set forth. All parts of each individual block shall be thoroly treated, and not less than sixteen pounds of the mixture per cubic foot shall be injected.

Method of Treatment: In preparing the blocks to receive the creosote resin mixture, they shall be placed in an air-tight cylinder where by means of dry heat or heat produced by superheated steam, in closed coils, and a vacuum pump, all sap in the blocks shall be vaporized and all moisture in them removed. When the blocks are thoroly dry and with a vacuum of 25 inches in the cylinder, after which hydraulic pressure shall be applied and maintained until the blocks have absorbed at least sixteen pounds of the creosote resin mixture to each cubic foot of wood.

Creosote or the Heavy Dead Oil of Coal Tar: The oil shall be pure coal tar creosote, distilled from illuminating gas tar, or coke oven tar, and shall contain no oil derived from water gas tar, oil gas tar, or other tars. The gravity at 68° F. shall not be less than 1.10. When distilled in a retort with the thermometer suspended one inch above the oil, up to 600° F., it shall lose not more than 35 per cent. The specific gravity of the residue shall not be less than

1.125. The oil must be clear, that is, there must be no substance in suspension. It must be absolutely soluble in benzol, so that it will readily penetrate the wood.

Resin: The resin shall be solid resin obtained from pine. It shall be reduced to a fine dust by grinding and then incorporated with the hot creosote oil in a suitable mixing tank until the proper proportions are secured.

Discussion of this paper will be found on page 244.

THE PROPER OIL FOR TREATING CREOSOTED WOOD BLOCKS FOR PAVING

By P. C. Reilly, Indianapolis, Ind.

The subject assigned me, "The Proper Oil for Wood Block Pavement," is indeed a very appropriate one at this time because of the confused condition of the creosoted wood block paving industry with respect to a specification for creosote oil. So far the industry has been conducted largely without the important foundation of a scientific standard of quality for its creosote oil and as a natural consequence there are many and varied oils and mixtures being used in treating wood block. The paving industry is suffering, and has suffered, from this weakness and it will, of course, continue to suffer until the weakness is corrected. The correction is possible only by the use of the proper oil and should be made without delay.

A Stable Oil Necessary

The question of treated and untreated blocks is a relative one. Untreated blocks have been used for a short period. These same blocks treated with any inferior material could reasonably be expected to give longer service; but this longer service would be yet far removed from the proper service. Any preservative which does not protect a wood block so that it will resist the wear of traffic until mechanically worn out, is defective. It is an error to use untreated blocks; it is very nearly as much of an error to use inferior oil-treated blocks. If the question were asked of any engineer, Do you specify sixteen pounds of oil to the cubic foot of timber because you believe that quantity of oil is required to treat the blocks? the answer would be, Yes. If you were then to ask the question, Would you use eight pounds to the cubic foot? the answer necessarily would be, No. Yet, if an oil is used—and its use requires the buying and paying for it—and when it is injected into the blocks it evaporates so rapidly that on exposure the quantity of oil is reduced from sixteen pounds to eight pounds, it follows, that the blocks are not, after exposure, properly treated and are at their highest state of perfection immediately after laying; and deterioration immediately begins and is continuous. These are unsound conditions. If the blocks need sixteen pounds of oil to the cubic foot

they need it at the end of five years and at the end of ten years and at the end of a longer period just as much as they do the first day the blocks are laid. And care should, therefore, be taken that only an oil is used that will protect them permanently.

Deficient Specifications

The many prevailing deficient specifications may perhaps in a measure be explained by the fact that the creosoted wood block pavement in a general sense is comparatively a recent pavement; and also because the manufacturers of creosoted wood block pavements, with one or two exceptions, rely for their supply of material upon manufacturers who produce creosote oil only as a by-product. The quality of the creosote oil so produced is therefore determined not by the necessary qualities of creosote oil for wood block pavements but by the kind and quality of the original or principal materials manufactured for entirely different purposes; and extraordinary efforts are being put forth by the manufacturers of this low grade material to compel the creosoted wood block industry to use it. This is an unsound basis upon which to manufacture or select this or any material, and failures have resulted and will continue to result from this attitude; and the use of such material will seriously reflect on the stability of this type of pavement.

The Adulteration of Creosote Oil

There is another feature to the problem which might as well be squarely faced and which has exerted an influence antagonistic to the proper improvement of this important pavement and that is the custom of adulterating creosote oil with coal tar, a practice which should be stopped. The specifications for the creosote oil should be so drawn as to guard against this adulteration.

It is to be regretted that more time has been devoted to the writing of ostensibly good specifications than would have been required to write a specification that would be scientific and would place the business on a truly substantial basis. To create a market for certain surplus material for use in the creosoted wood block industry, altho the material so considered would not be a creosote oil, seemingly has been the dominant thought in the minds of some material men and their employed chemists and engineers. The municipal engineer does not profess to be an expert on creosote oil and has not a knowl-

edge of the many adulterants that could be and have been used in doping the oil. He accepts such specifications from those whom he considers to be well versed in the subject and upon whom he of necessity relies for the proper specification for wood block pavement. It soon develops that the specifications were merely means of evading sound specifications and permitting the substitution therefor of unsound and unscientific specifications. The municipal engineer has been deceived and the pavement has not measured up to the quality to be expected. Perhaps all industries have to confront pernicious influences but it seems as if the creosote block industry is getting more than its share.

Loosely Drawn Specifications

Specifications of this character, from their very nature, must be loosely drawn; and a loosely drawn or indefinite specification as to quality of material has no place in engineering construction work. The use of material other than creosote oil under indefinite specifications has been a source of profit which is a stimulus to encourage the continuance of such specifications.

As an illustration of what has been called "a loosely drawn specification," your attention may be called to the wording of the specification considered by you at your Convention in Boston a year ago, as follows:—

American Society of Municipal Improvements Specification for Creosoted Wood Paving, 1914

1. Shall be a product of coal gas or coke oven tar.

Specific gravity at 38°C.	1.08 to 1.14
Distilling to	
150°C	.00 to .00
170°C	.00 to 0.5
210°C	2.0 to 6.0
235°C	8.0 to 16.0
315°C	30.0 to 45.0
355C°	45.0 to 60.0

Specific Gravity dist. (60°C) 235-315°C above 1.02.

Do Not Call for Creosote

Your attention is called to the word "creosoted" which occurs in the caption of this specification. It is especially to be observed that

this word is found nowhere else in the specification. The specification itself is in conflict with its title. One would naturally infer from the title that the preservative required would be a creosote oil and that the blocks produced would be creosoted blocks. Yet it is a fact that creosoted blocks are not at all required by the specification and will not be produced under it. The requirements for the preservative are as follows: "the preservative to be used shall be a product of coal gas or coke oven tar." What a loose attempt at describing or defining the material! For instance, let us analyze the term "product of coal gas or coke oven tar." It may mean a mixture of coal tars or a mixture of coal tar with some of its distillates, or a mixture of pitch cut back with some of the coal tar distillates, or it could mean a pure distillate oil, or it could mean tar itself with any slight alteration or addition being made to it; provided only that the mixture or mixtures so made will respond mechanically to the distilling tests and the viscosity tests prescribed in the specification; and it is known that these distilling tests and viscosity tests can be met by manipulating these different mixtures. For if the specifications were drawn to conform to the title, the article, creosote oil, being a specific article, there would be an intelligible and definite interpretation of the specification by everyone. But in the specification, as written, the important elements of the quality and uniformity and the kind of oil are entirely disregarded. And quality and kind of the preserving oil are, of course, the essence, and should be the essence of the specification. A "product of coal gas or coke oven tar" is so indefinite as to quality that if four or five or six creosoted block manufacturers were furnishing blocks to one city, altho all would be manufactured under the same specification, the blocks from any two manufacturers might not be alike in quality; indeed the chances are that some of the blocks would be widely different in quality. It is indeed a question if such a specification is legal. It is agreed that a suitable quality of material and uniformity in a paving material are most desirable and most necessary features, yet this "product" specification would be peculiar in that its function would be to defeat this very important feature. For, under it, a municipality would only get an inferior material and never the best material. So unscientific and indefinite a specification as to quality must therefore be repudiated. The following tables will illustrate and explain the great range of material which must be accepted under the very unscientific classification of "product of coal gas or coke oven tar."

I shall first give a description of the coal tar and creosote oil I used in making a mixture to comply with the specification submitted for your consideration at Boston, a year ago.

COAL TAR (COKE OVEN)

Specific gravity 38°C	1.160
Distillation at	
200°C	0.5
210°C	2.5
235°C	9.0
250°C	11.5
285°C	19.5
315°C	25.0
335°C	29.0
355°C	35.0
Sp. Viscosity	
Oil 82°C, water 20°C	2.267
Evaporation 49°C	
in 72 hours	8.73
144 hours	11.36
216 hours	13.34
288 hours	15.00
360 hours	15.76
432 hours	16.48

This coal tar of itself will not meet the specific gravity and distilling tests prescribed in the proposed Boston specification so we add to it some creosote oil (German creosote oil) in the proportions of three parts coal tar to one part of creosote oil.

GERMAN CREOSOTE OIL

Specific Gravity 38°C	1.080
Distillation to	
200°C	0.5
210°C	2.5
235°C	7.5
250°C	18.5
285°C	40.5
315°C	55.5
335°C	69.5
355°C	77.5

Sp. Viscosity (Engler)	1.133
Oil 82°C. water 20°C.	
Evaporation 49°C	
in 72 hours	15.41
144 hours	19.36
216 hours	22.78
288 hours	25.74
360 hours	27.26
432 hours	28.78

In mixing the above coal tar and the above creosote oil in the proportions as stated, three parts coal tar and one part creosote oil, a mixture will be made which complies with the specification proposed at Boston, as follows:

MUNICIPAL IMPROVEMENTS OIL

Mixture, Coal Tar 75%	
Creosote 25%	
Sp. gravity 38°C.	1.137
Distillation to	
200°C	1.0
210°C	2.0
235°C	10.0
250°C	16.0
285°C	27.0
315°C	35.0
335°C	41.0
355°C	47.5
Sp. Viscosity (Engler)	
Oil 82°C. water 20°C.	1.627
Evaporation 49°C	
in 72 hours	7.72
144 hours	11.27
216 hours	14.56
288 hours	17.36
360 hours	18.70
432 hours	19.95

This specification cannot be said to be a "creosoted" wood block specification. It is instead a tarred wood block specification and greatly inferior to a "creosoted" wood block specification.

Evaporation Test

I wish to call your attention especially to the evaporation test of each, the coal tar and creosote oil and also of the mixture made with them; the mixture being three parts of tar and one part creosote oil; the exposure being at 49°C; the coal tar lost 16.48%, the creosote oil lost 25.74% and the the mixture lost 28.70% in 18 days. The tar and the oil used in this mixture represent the highest qualities of tar and oil and the resulting mixture therefore can be said to be a product of coal tar specification of the highest quality. And its deficiency is so apparent it is unnecessary to talk about it. The quality of the creosote oil used is very much better than the creosote oil ordinarily obtained. And it is doubtful if any of this quality has been used in the coal tar product specification. Yet notwithstanding this fact, the mixture of the two shows such a high evaporation in so short a time of exposure that it is an inferior and unsuited material with which to manufacture paving blocks. The deterioration of this mixture, because of its evaporation, is characteristic of such a mixture and the deterioration is greater when a less stable creosote oil is used; and the creosote oil used in making the products of coal tar is, as those engaged in creosoting know, much more volatile and of inferior quality to that used in making the mixture I show in this table. But the coal tar usually undergoes chemical changes constantly and continuously which, of course, means a steady deterioration of the block.

Close in the wake of the above specification (the Boston specification was not nine months old) comes another specification drafted by the Creosoted Wood Paving Block Bureau's committee which, it is said, was drawn to definitely limit the proportions of coal tar that may be added to creosote oil. This specification is as follows:

Wood Preserver's Oil for Wood Block

Product of Coal Tar.

Sp. gravity 38°C	1.07 to 1.11
Distillation to	
210°C not over	5.0
235°C not over	30.0
315°C not over	50.0
355°C not over	70.0
Sp. Viscosity	
Oil at 82°C, water at 20°C not over	1.20

(Several modifications of residue (above 355°C).

The Word "Creosote" Dropped.

The above table gives the principal points. In the title of this specification the word *"creosote"* has been dropped and the preservative is to be known as a "wood paving block oil" and must fall within prescribed limits as shown by the outline in the table. You will remember that this specification was "drawn to definitely limit the proportions of tar that may be added to the distillate of creosote oil." What limitation of tar the committee had in mind they unfortunately failed to state—seemingly a desired evasion in wood block specification—so in order to gain some kind of an idea of what the words "definitely limit the proportions of tar" (Wood Preservers' Journal, Vol. 11, No. 3, P. 44, issues July and September, 1915) mean, it will be necessary for us to find out, if possible, some of the recent views of any or all of the members of the committee who drafted these specifications. Referring to the article written by one of the committee and published in the Proceedings of the American Railway Engineers' Association, Vol. 15, 1914, several references occur to the mixing of coal tar with creosote oil and in several places the mention of 20% tar and 80% creosote oil is made and considered a maximum amount of the tar in the mixture. From this it would seem that any more than 20% of tar added to the creosote oil would be bad practice. The specification, however, will allow over 40% of tar.

Coal Tar (Coke Oven)

Specific gravity 38°C	1.160
Distillation to	
200°C	0.5
210°C	2.5
235°C	9.0
250°C	11.5
285°C	19.5
315°C	25.0
335°C	29.0
355°C	35.0

Specific viscosity (Engler)	
Oil 82°C, Water 20°C	2.267
Evaporation 49°C	
in 72 hours	8.73
144 hours	11.36
216 hours	13.34
288 hours	15.00
360 hours	15.76
432 hours	16.48

This is an analysis of a low-carbon coal tar, such as was suggested in the quotation just cited above, and mixed with a creosote oil as shown in the following:

MAINTENANCE-OF-WAY

ENGLISH CREOSOTE OIL

Specific Gravity 38°C.	1.040
Distillation to	
200°C	3.0
210°C	5.5
235°C	31.5
250°C	48.0
285°C	67.5
315°C	80.0
335°C	85.5
355°C	90.0
Sp. viscosity (Engler)	
Oil 82°C. water 20°C.	1.085
Evaporation 49°C	
In 72 hours	20.47
144 hours	28.96
216 hours	36.75
288 hours	43.77
360 hours	46.84
432 hours	49.68

In the proportions of 41% tar and 59% creosote these will make a mixture as represented by this analysis:

Wood Preservers' Oil

Mixture: Coal Tar 41%	
Creosote Oil 59%	
Sp. gravity 38°C.	1.087
Distillation to	
200°C	1.0
210°C	4.0
235°C	20.0
250°C	31.5
285°C	48.0
315°C	56.5
335°C	63.0
355°C	70.0
Sp. Viscosity (Engler)	
Oil 82°C. Water 20°C.	1.20
Evaporation 49°C	
in 72 hours	13.09
144 hours	19.04
216 hours	24.22
288 hours	28.42
360 hours	30.63
432 hours	32.73

41% Tar in This Mixture

You will notice that the mixture consists of 41% tar and 59% creosote oil. This is the most recent wood block oil specification and is supposed to be the best preserving oil known for wood block paving, if the work of "The Creosoted Wood Paving Block Bureau's Committee" stands for quality, purity and endurance of paving oil. Does that specification call for material of high quality? Does the mixture, as shown here, stand for high quality? No; certainly it does not. Lunge, 4th Ed. Vol. 1, P. 541, in enumerating the various materials patented by Bethel in 1838 says: "Amongst them is a mixture consisting of coal tar, thinned with from one-third to one-half of its quantity of dead oil distilled from coal tar; and as late as 1849 Bethel's licenses mentioned the admixture of gas tar." "In those times inspectors frequently refused to allow the dead oils to be used without being thickened with tar (Boulton P. 14) as it was

not understood that the pitch was only an impediment to the injection." "This must have been recognized very soon after." "The dead oils came into use *alone;* and then crept into the specifications the contradictory prescriptions that the wood was to be creosoted according to Bethel's Patent but that the creosote was to be free from *adulteration* with coal tar." We want the best and if creosote oil not mixed with tar has been known to be the best for almost three-quarters of a century, we cannot sanction a specification now that is the extreme of what was condemned so many years ago and when it is known that coal tar, because of its chemical and physical nature, is an inferior preservative.

Tar Sensitive to Heat and Cold

To return to the specification which we were considering, I want to say in regard to the tar used in this mixture (and it is a representative low-carbon coke oven tar) a quotation from Mr. R. P. Perry is very appropriate. In discussing the properties of low-carbon tar, in an article in the Journal of Industrial & Engineering Chemistry, Vol. 4, No. 2, Feb. 1913, P. 153, Mr. Perry says: "They yield pitches which are extremely subject to temperature influences, being very brittle when cold and easily flowing when heated, and are unsuited for many pitch uses." And it may be added that this class of tars is as rightfully unsuited for use in treating wood block as it is for pitch, and for the very same reasons as given by Mr. Perry—the sensitiveness of the tar to heat and cold. It is always this inferior tar that it is contemplated to use in the "tar mixture" oils, probably because as it will not make good pitch it "might" make good paving blocks. But it will make no better blocks than pitch. Its use is also encouraged because it is light and will more nearly come within the prescribed limits of the specific gravity set out in the specifications; and this will lessen the quantity of creosote oil needed to bring the mixture within the maximum gravity. Because of the fact that this coal tar is an inferior one, it is well for you to bear in mind that it is a cheap material and the cheapest obtainable material that can be used under these specifications.

Inferior Mixtures

In the next analysis to be shown we have the "Wood Block Paving Oil" made up of the same "inferior tar" and with a volatile creosote oil, the cheapest portion of creosote oil. This light portion of creo-

sote oil is used for the reason that less of it will be required to bring the coal tar (the price of coal tar is about 30% of creosote oil) within the limits of the specific gravity and also because of its cheapness. You observed that the mixture just exhibited above was composed of a coal tar and light creosote oil. Now I will show you how the same coal tar and a more inferior creosote oil may be used to produce a mixture that will comply with the specifications under consideration.

WOOD PRESERVER'S OIL FOR WOOD BLOCK.

Mixture: Coal Tar 44%
Volatile Creosote 56%

Sp. gravity 38°C	1.075
Distillation to	
200°C	0.5
210°C	3.0
235°C	30.0
250°C	52.0
285°C	65.0
315°C	69.0
335°C	71.5
355°C	74.0

Sp. viscosity (Engler)	
Oil 82°C, Water at 49°C.	
In 72 hours	25.24
144 hours	33.44
216 hours	47.53
288 hours	52.38
360 hours	56.02
432 hours	58.07

NOT A CREOSOTE OIL SPECIFICATION.

This mixture consists of a very light creosote oil (1.025 sp. gr.) and the same tar as was used in the other mixture. The specification is not a *creosote oil specification,* nor is that claim made for it or suggested; but there is no getting away from the fact that it is a *coal tar* (thinned with some light creosote oil) *specification* wherein

the materials used consist of a cheap tar and a cheap creosote oil and that it is a "product of coal tar" specification.

One of the fundamental considerations in the selection of creosote oil is its volatility. A study of the tables already given and which follow, will convince any one of the utter absurdity of the suitability of some of the oils for treating wood block. It is evident that the oils which are so strongly urged for use in wood block are so volatile as to permit the cells in the wood to become empty and unprotected on account of rapid evaporation of the oil. Engineers would not construct a bituminous pavement with a material that would volatilize and leave the mineral aggregate without needed protection. The illustration is applicable to creosoted blocks. You cannot use an oil for the protection of blocks and expect protection from it if it evaporates. Further, the oil originally injected into blocks occupies space. When it leaves the blocks there is a space to be filled, and instead of preservative elements occupying the space, destructive elements fill it. It is very obvious, therefore, that the use of a non-volatile material in wood block pavement is absolutely essential to obtain the desired and proper service.

The Creosote Oil Should Be Permanent.

The oil should be of such a character as to permanently protect the wood fiber against decay and also waterproof the fiber and remain permanently in the block. The oil should be of such a character that it will undergo little or no chemical change during the mechanical life of the block. It is not sufficient to preserve wood block against germ attack only, for if that were true all that would be necessary to protect a paving block would be to treat it with a little zinc chloride solution (a 3% or 4% solution) or a little light creosote oil, or a mixture of these two antiseptics. The fiber must be permanently waterproofed to such an extent as to minimize the effects from contact with water. And the treatment must be of such a nature that the fiber will always be supported by the oil it receives from the original treatment and this can be done only by using an oil that will permanently remain in the wood fiber. Wood fiber so protected reduces the element of expansion to a minimum and thus overcomes the destructive effects of expansion of the pavement.

Cross Ties and Paving Blocks.

The material required for treating cross ties and the material required for treating wood blocks are not the same. The creosote oils customarily used for treating ties are not suitable for treating wood paving blocks. But any creosote oil suitable for treating wood paving blocks is a very superior oil for treating ties. A tie may be treated with metallic salts so as to insure it against decay during its mechanical life; a paving block cannot be successfully treated with metallic salts because they are soluble in water and will leach from the block; and because the fibers of the wood block must not only be made permanently antiseptic but likewise permanently waterproofed so as to prevent expansion as well as decay of the fibers of the wood.

The position and exposure of ties to the destructive elements are minimized by the horizontal position of the fiber of the ties and their position in reference to drainage. Again the position and length of the capillary tubes in a tie possess great advantages over the same elements in a paving block. For instance, in the tie the capillary tubes are approximately thirty times as long as those in a paving block and it is evident that the preservative can, and does, penetrate a considerable distance into the long tubes and it thus comparatively becomes favorably situated to evade loss by evaporation and effects of water; for should the temperature of the tie become sufficiently high to cause some volatilization these vapors would linger along in the small cavities and before much of it had escaped the cooler atmosphere of night would cause condensation of these vapors, so that this same action might be repeated over and over. The case with the wood block is quite different. Here the capillary tubes are short and placed perpendicularly, thus affording easy and natural escape for any vapors forming in the tubes and consequently the free access of water to the empty tubes. Thus, it is evident that a lighter and more volatile creosote oil may be used, with assurance of good results, in treating ties than can be used in treating paving blocks.

For a standard article there should be a *standard* specification so applicable and well suited for the purpose as to render unnecessary the annual or semi-annual changing of the specifications in National Conventions.

Deceptive Method of Obtaining Specific Gravity.

The following illustration will show how coal tar and light creosote oil may be manipulated to produce the gravity of a high-grade creosote oil.

Method of manipulating two inferior materials to meet a ***required*** specific gravity of a high-grade creosote oil, the specific gravity required being 1.10.

Given:

The inferior creosote, specific gravity	1.02	
The coal tar	1.18	
Specific Gravity of Mixture		1.10

How Specific Gravity is Produced.

Here you will see that the specific gravity of the tar used is 1.18 and that of the light creosote 1.02. A mixture of equal parts of these two materials will produce a material having a specific gravity of 1.10 which corresponds to the specific gravity of a high-grade creosote oil. The gravity obtained by mixing these two inferior materials, neither of which is adapted for treating wood blocks, is, in the absence of other definitely specified characteristics of the ingredients composing this mixture, meaningless and unintelligible for the reason that this quality, "gravity," is common to any and all tars and oils regardless of origin. The use of such a mixture may be technically permissible under the indefinite and generic classification, "Product of Coal Gas or Coke Oven Tar," but wholly unfit for the purpose of treating wood paving blocks, and it is for this reason I wish to emphasize the necessity for a specification that is clearly and scientifically written. That there may be a reason for the active and urgent work put forth by some to have such a specification put in force is illustrated by the following analyses which show the profit when tar mixtures are substituted for high-grade creosote oil:

Preserving Mixture.

A-44 parts Coal Tar at .04 per gallon..........	.0156	
56 parts inferior Creosote Oil at .06..........	.0336	
Price per gallon of mixture......................	.0492	.0492
B- 3 parts Coal Tar at .04 per gallon...........	.03	
1 part Maintenance-of-Way Oil at .08.......	.02	
Price per gallon of Mixture.....................	.05	.05

HIGH GRADE PURE CREOSOTE OIL.

1 gallon High-grade Pure Creosote Oil .... .12

Illustration:

If 5 gallons were used per sq. yd.
Cost of Mixture "A" is .... .246
Cost of Mixture "B" is .... .25
Cost of high-grade Pure Creosote Oil is .... .60
Profit by using either "A" or "B" is 35 cents per square yard.

QUALITY AND PRICE CONTRASTED.

If a definite oil is expected in an indefinite and ambiguous description of the material, then you may rest assured the cheapest material that will meet the requirements will be used. You will observe that the coal tar and creosote oil are like some already described as a cheap tar and a cheap creosote oil. The cost of this low-grade material and that of a high-grade creosote oil are set out in contrast and you will see at a glance what profits are derived from the inferior mixture when it is substituted for high-grade creosote oil. This brings to your attention the fact that specifications can be so ambiguous in meaning as to demoralize competition. As has been shown, a mixture of coal tar, the cost of which is one-third that of a high-grade creosote oil, and a very inferior quality of creosote oil, may be made to answer the tests of a high-grade creosote oil, and when the title of a specification is "creosoted block", from all surface appearances the specification calls for a high-grade creosote oil; and many contractors may so consider it while others may take the opposite view and when bids are called for, some, not wishing to chance a bid on a "Product of Coal Tar," bid on "High-grade Creosote Oil," while the less scrupulous contractors bid on "Product of Coal Tar" and force the acceptance of their goods, because the specifications allowed the use of either high or low-grade oils, even though it may have been intended by those who drafted the specification that only a high-grade creosote oil should be used. No specification should be adopted by this or any other Association until it is so clearly worded as to permit of but *one* interpretation as to the grade, kind and quality of the oil required.

AN APT ILLUSTRATION.

That this matter may be brought more closely home to every one of you, I will call your attention to the following illustrations:

I. Showing how a high-grade material is rendered inefficient by adulteration.

1 gallon high-grade lubricating oil	60 cents
1 gallon low-grade lubricating oil	10 cents
	70 cents
1 gallon of Mixture	35 cents

II. What kind of a substitute would the following mixture make for a high-grade lubricant?

1 gallon lubricating oil	10 cents
1 gallon crude petroleum	4 cents
	14 cents
1 gallon of mixed oil	7 cents

"The Mother Liquor."

It is frequently asserted that adding coal tar, an article very inferior to creosote oil, to *creosote oil,* cannot be said to be adulterating the creosote oil, because coal tar is the "mother liquor". Adding coal tar to creosote oil is, of course, adulteration as already quoted in this paper from Lunge. Coal is produced by decomposition of vegetation under certain conditions of the natural elements, heat, moisture and pressure. Coal tar is produced by distillation from coal; creosote oil is produced by distillation from coal tar. The illustration may be extreme but it is just as correct to say that vegetation in the transformation state from the plant to the coal is the mother of creosote oil as to say that coal tar is. If vegetation in the coal-forming stage (lignite for example) were mixed with coal and the mixture could be sold as unadulterated coal, or if coal were mixed with coal tar and the mixture could be sold as unadulterated coal tar, then it could be said that coal tar mixed with creosote oil is not adulteration. The mixing of different materials, or mixing of a low-grade material with a high-grade material of the same source is adulteration; and the adding of coal tar to creosote oil is gross adulteration.

An adulterant may be like the adulterated material—in such case they differ in degrees of refinement or source; e. g., maple syrup adulterated with sugar-syrup, etc.

Creosote oil is a refined product from coal tar, coal tar being the source or "mother liquor" of the creosote. The addition of creosote oil to coal tar is not adulteration because the creosote is the more refined and expensive of the two materials. The addition of coal tar to creosote oil is adulteration because coal tar is the crude material from which creosote is obtained and, further, coal tar is much cheaper than creosote oil. Whether or not the addition of one liquid to another liquid forms a homogeneous combination does not in any sense determine whether or not adulteration has been exercised. In other words, when one or more materials are added to a superior material, it matters not whether the combination forms a "solution" or a "mixture", in either case the addition of the inferior material constitutes adulteration.

If there is nothing wrong in adding crude material to refined material, or low-grade to high-grade oil, and the one is just as good as the other, then the above illustration will suggest to you how to obtain efficient oil at very little cost. We can make an illustration that is directly personal. For instance, if gasoline is worth 14 cents per gallon and crude petroleum is worth 4 cents per gallon, we can take a gallon of crude petroleum and a gallon of gasoline and mix them in equal parts and our gasoline would only cost 9 cents per gallon instead of 14 cents per gallon. But you won't do this for the very good reason that if you add the crude petroleum to the gasoline you will so destroy the efficiency of the gasoline that it will be useless for the purpose for which you purchased it; likewise, if we add the low-grade lubricating oil to the high-grade, making the cost of the mixture only 35 cents per gallon, we do it at the expense of efficiency.

The Structure of Cells in Wood.

Your attention will now be called to the structure of cells in wood. Figs. 1 and 2 show the large thin-walled cells of spring growth and the thick-walled cells with small cavities of summer growth. It is the cell walls (fiber or cellulose) that must be protected against destructive elements, such as *molds* which destroy the composition of the cellulose, and *water* which weakens the strength of the fiber and renders it easily broken down by external impact or pressure. In order to protect the cell walls against the attack of fungi it is necessary to do more than merely enclose a collection of fibers in a

thin waterproof covering, as illustrated by the hollow paper fiber cylinders, Fig. 3, capped at each end, covered with a thin film of pitch which does not penetrate the fiber, similarly to the residue of tar oils, being composed of volatile oils and this character of residue, this residue being in liquid form at the time of use because of the admixture of the volatile oils. This cylinder is water proof and germ-proof from external sources, but internally the fiber has no protection at all. When a little external pressure is directed against the cylinder, the pitch coating cracks, in time pulls off, and, as you see, the fiber is exposed to any and all external destructive elements that may

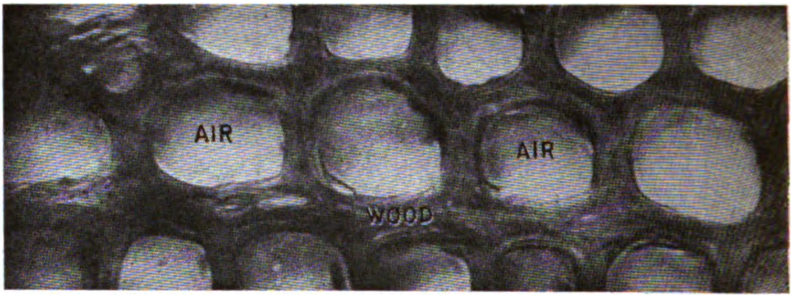


Fig. 1 showing wood fiber and ring cells in spring growth timber.

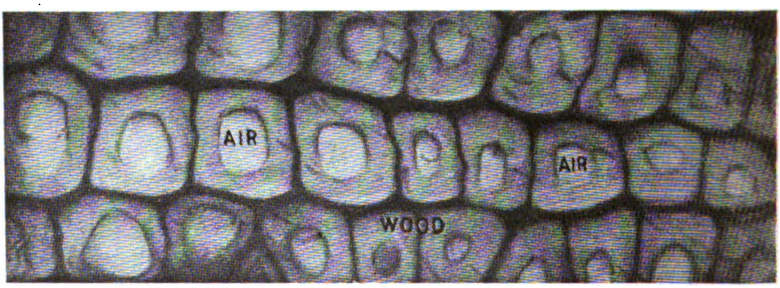


Fig. 2 showing wood fiber or ring cells in summer growth timber.

The above cuts show the cell-walls (wood fiber) and pores or capillary tubes of wood structure. In order to protect wood fiber against the destructive effects of fungi and such natural elements as heat and moisture the cell-walls must be made germ-proof and water-proof by surrounding them with a material that is both antiseptic and water-proof in character and will remain permanently about the fiber. The fiber (paper) rings in Figs. 3. 4 and 5 are used to illustrate the effect of moisture on fiber in wood.

THE FOLLOWING FIBER (PAPER) RINGS ARE USED TO ILLUSTRATE THE EFFECT OF MOISTURE IN THE WOOD:

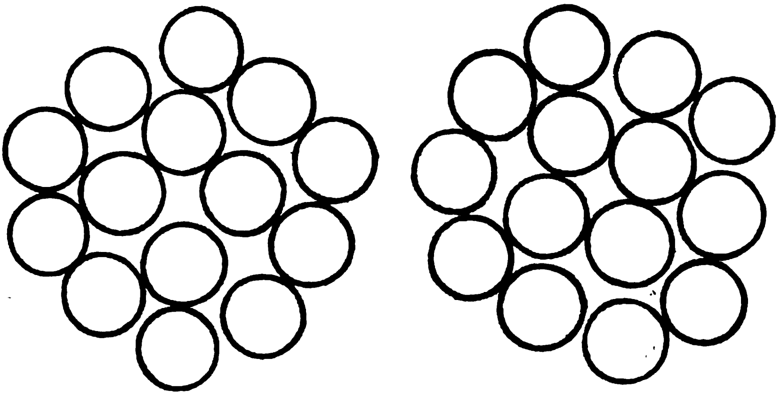


Fig. 3 (reduced to one-quarter original size) shows uncreosoted paper rings on left; creosoted paper rings on right. Neither of these sets have yet been immersed in water.

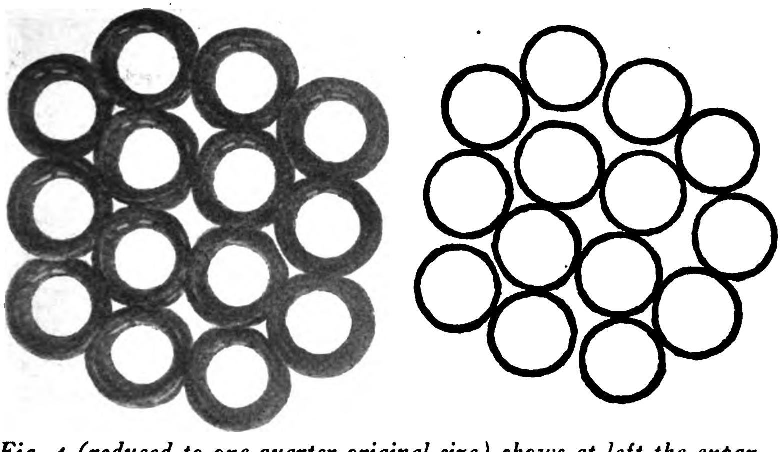


Fig. 4 (reduced to one-quarter original size) shows at left the expansion of Fig. 1, which was not creosoted, after 60 minutes immersion in water. At right shows Fig. 3, right, which was creosoted, after sixty minutes immersion in water.

These illustrations parallel the exposure of wood fiber or cell rings of wood in paving blocks; and also parallel the effect of moisture on untreated or imperfectly treated fiber in wood blocks. If the treated fiber is not protected against moisture the fibers expand, and, of course, the blocks expand, and it follows that the pavement as a whole will expand. This illustration of the unaffected condition of the properly creosoted rings at the right emphasizes the only means of correcting expansion in wood block pavements; that is, the fibers in each block must be so treated that they shall be unaffected by moisture. The effect of expansion is clearly shown at the left.

present themselves. In order to illustrate this point in another way, here are a number of cylindrical rings of paper fiber, Figs. 3 and 4, some of which have been treated with a creosote oil of 1.11 specific gravity and some which have not been treated at all. We will fill these rings with water and note what effect it will produce on the wall structure. These little rings will well represent the cell walls of wood fiber. On examination of these rings, after allowing them to stand for some time, you will observe that the cell walls of the untreated ones become soft and are easily mashed together and broken down, while the rings which were treated show no sign of swelling and the fiber is rigid

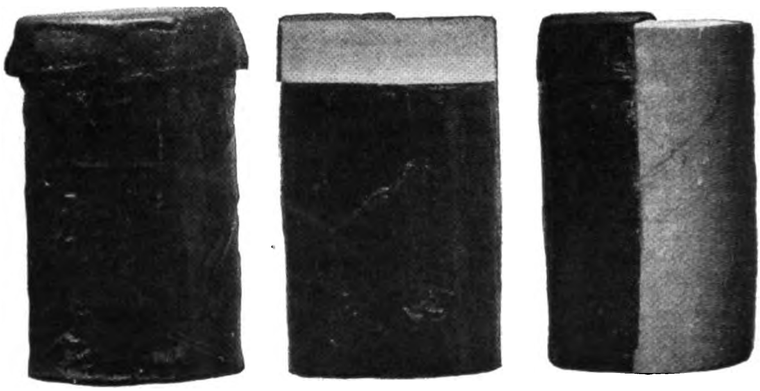


Fig. 5. A fiber (paper) cylinder which has been immersed in a tar-mixture residue, at the right. One which has been immersed in a tar mixture residue is in the center; the removal of the cap showing the clean under surface. The coating of tar-mixture residue is brittle and non-adhesive and readily peels off from the surface of the cylinder; it is inert matter and useless for this purpose. The picture at the right shows the tar-mixture residue removed from one-half the cylinder. This is very brittle. Its adhesion to the fiber is very weak, as is demonstrated by its clean removal. Exposure of a tar mixture, composed of volatile oil and tar, results in such a residue. It has neither preservative properties nor water-proofing qualities.

and at its normal strength. What is seen in this illustration may be seen whenever poorly treated and well treated wood blocks are examined. And I wish to emphasize that if the preserving material

is a worthless, inefficient, unstable substance the life of the blocks will be short; but if the preserving medium is of a stable, high-grade material that will retain its composition, the fibers treated will, not merely for a time only, but always, possess their full strength; and so the blocks, not weakening continually by the deterioration of the treating fluid, are capable of withstanding the wear they are subjected to; not so with the blocks treated with an improper oil.

In some wood block specifications there has been a requirement that the blocks shall, after treatment, show not more than 3½% to 5% absorption of moisture after having been dried for twenty-four hours and immersed in water for twenty-four hours. This test alone is a dangerous one. A block painted with tar, or pitch, or paint, and having no interior treatment whatever, would successfully pass this test; yet a block so treated would be absolutely unsuited for use in a wood block pavement.

Source of Creosote Oil.

I shall now take up the subjects of the source, classification, analysis, and chemical and physical properties of creosote oil.

Coal tar is the source of creosote oil. There are two chief sources from which coal tar is obtained; in the manufacture of coal gas and in the manufacture of coke. Tar is a black, more or less viscous substance and instead of being a single chemical compound it consists of a great number of different compounds.

Coal Tar.

Carbon	5.50
Specific Gravity 38°C	1.180
Distilling to	
200°C	1.00
210°C	3.00
235°C	6.00
250°C	8.50
315°C	20.00
355°C	28.00

Here is the analysis of a representative coal tar which you will observe has a specific gravity of 1.18. Creosote oil is derived from coal tar by the agency of heat; the process being termed "distillation." When a material is subjected to distillation, the vapors which pass

over and are condensed, retain the same chemical and physical properties as the original material; or the distillate may be composed of entirely different compounds than any that existed in the original material. When a distillate is of the same composition as that of the original material, the process may be termed "simple distillation"; e. g., the distillation of water. But when the distillate is of a composition entirely different from the original material, then the process of distillation is called "destructive distillation." In the process of destructive distillation the atoms in the molecules are rearranged and produce hydrocarbon compounds which did not originally exist in the oil or Tar, some of which are less stable than the original compound and some much more permanent.

In the distillation of coal tar both of these processes take place.

LIGHT CREOSOTE OIL.

Sp. gravity 38°C	1.025
Distillation to	
200°C	6.0
210°C	25.5
235°C	75.5
250°C	85.0
285°C	94.0
300°C	96.0

Here is a representative creosote oil and for the most part is of the same composition as existed in the tar. This distillate is by no means a simple chemical compound but is a heterogeneous material composed of a great number of compounds, some of which are liquid and some solid at the ordinary temperature (70°F.). In general it is true that those distillates coming over at a comparatively low temperature retain their identity; that is to say, they exist in the distillate in the same form as they existed in the coal tar; e. g., if napthalene exists in coal tar, and the tar is subjected to distillation, the napthalene will volatilize at a comparatively low temperature and pass out of the tar and be condensed as napthalene. Some of the light oils and crystalline substances, which go to make up the complex body of coal tar, are recovered from the tar by direct distillation as in the case of napthalene.

MAINTENANCE-OF-WAY ENGLISH CREOSOTE OIL.

Specific Gravity 38°C	1.040
Distillation to	
200°C	3.0
210°C	5.5
235°C	31.5
250°C	48.0
285°C	67.0
315°C	80.0
335°C	85.0
355°C	90.0
Sp. viscosity (Engler)	
Oil 82°C, water 20°C	1.085
Evaporation 49°C	
In 72 hours	20.47
144 hours	28.96
216 hours	36.75
288 hours	43.77
360 hours	46.84
432 hours	49.68

This, as you will observe, represents a distillate of a higher specific gravity and contains compounds of a higher boiling point than those shown previously. While this distillate, like the one already described, is a mixture of many compounds, some liquids, some solids at ordinary temperature, yet it is quite reasonable to believe that all of the compounds which go to make up the oil, did not exist in the tar originally but consist of a mixture of original compounds mixed with a few "decomposition products."

GERMAN OIL.

Specific gravity 38°C	1.080
Distillation to	
200°C	0.5
210°C	2.5
235°C	7.5
250°C	18.5
285°C	40.5
315°C	55.5
335°C	69.5
355°C	77.5

Sp. viscosity (Engler)	1.133
Oil 82°C, Water 20°C	
Evaporation 49C	
in 72 hours	15.41
144 hours	19.36
216 hours	22.78
288 hours	25.74
360 hours	27.26
432 hours	28.78

This table shows a distillate of a higher specific gravity than either of the preceding distillates and you will also observe that as the gravity of these oils increases, the boiling point increases. You will also further note on observing the notations on evaporation of the distillates that as the boiling points increase the percentage of volatile materials decreases, which may be taken as an evidence that as the distillation of coal tar proceeds, the distillates contain more and more of the decomposition products, while those products, as stated, in the beginning of the distillation were largely composed of the same compounds as originally existed in the coal tar, we may proceed with the distillation to such a point that the material which passes over as a distillate will contain little or none of the compounds which originally existed in the coal tar.

When a distillate oil reaches a specific gravity above 1.11 at 38°C, it is as represented in this analysis:

HEAVY CREOSOTE OIL.

Specific Gravity at 38°C	1.112
Distillation to	
200°C	0.0
210°C	0.5
235°C	2.5
250°C	4.5
285°C	13.0
315°C	29.0
335°C	37.5
355°C	52.0

Sp. viscosity (Engler)	
Oil 82°C, Water 20°C	1.278
Evaporation at 49°C	
In 72 hours	8.64
144 hours	10.78
216 hours	12.64
288 hours	14.14
360 hours	15.00
432 hours	15.72

It will be noted that the phenol and napthalene products have decreased to a very low percentage in comparison to the amounts of these distillates as shown in the light creosote and English creosote oils. It will also be noted that the amount of oil volatilized at 49°C (120°F.), in a given time, decreases very much as the specific gravity of the creosote oil increases, thus showing that the higher distillates are decidedly more resistant to the effects of the high temperature of summer heat and that as the distillation proceeds the distilled oil continues to approach more nearly an ideal material for preserving wood blocks. It is necessary to continue this process of distillation until a point is reached when only "destructive distillation" products compose practically all of the distillate before what may be termed an ideal preserving oil is obtained.

IDEAL CREOSOTE OIL.

Specific gravity 38°C	1.138
Distillation to	
200°C	0.0
210°C	0.0
235°C	0.0
250°C	0.0
285°C	1.5
315°C	6.0
335°C	16.5
355°C	32.5

Sp. viscosity (Engler)	
Oil 82°C, Water 20°C	1.511
Evaporation 49°C	
In 72 hours	0.46
144 hours	0.51
216 hours	0.84
288 hours	0.92
360 hours	1.33
432 hours	2.04

The Ideal Paving Block Preservation.

This shows the qualities of a truly ideal paving block creosote oil. On close examination and comparison of the qualities of this oil with those shown by the preceding analyses, it will be observed that from several viewpoints this oil is the climax in respect to specific gravity and volatilization and it may also be stated that it is very resistant to any and all destructive atmospheric agencies and possesses antiseptic properties sufficient to destroy all germ life. The material is sufficiently limpid at the average temperature used in treating wood to afford perfect penetration and the very nature of the oil as to physical and chemical qualities is capable of satisfying the most rigid and exacting requirement for wood preservation.

As a suggestion for a specification for your consideration and study, in closing my remarks, I will present the following:

Improved Creosote Oil.

1. The oil shall be obtained by the distillation of coal tar and shall consist wholly of such distillate from coal tar as will comply with the following requirements:

2. The oil shall have a specific gravity of not less than 1.12 nor more than 1.14 at 38°C.

3. When the oil is subjected to distillation the distillates shall be as follows:

Distillate to 250°C not over 1%
Distillate to 315°C not over 15%
Distillate to 355°C not over 40%

4. The residue above 355°C shall be of a soft waxy nature at 25°C. When a drop is heated on white filter paper until it is absorbed by the paper, the spot formed, when viewed by transmitted light, shall be of a yellowish amber color.

5. When 25 grams of the oil are placed in an open pressed tin box approximately 2½" in diameter and ¾" deep and kept at a temperature of 49°C (120°F.) it shall not lose more than 5% by evaporation in 72 hours.

TESTS.

The residue above 355°C shall have a specific gravity of not less than 1.17 at 25°C.

The residue above 380°C shall be of a soft waxy nature at 25°C.

The specific gravity of the fraction of the distillate 400°C to 420°C, shall be not less than 1.12 at 38°C.

Sulphonation: When the following fractions of the distillate, 315°C to 380°C and 380°C to 420°C, are subjected to the sulphonation test neither of them shall contain more than 2% of unsaponifiable oil in that particular fraction.

And I would suggest that any specification adopted by this Association should be so drawn as to exclude the use of coal tar or any other kind of tar from the preservative oil and that the preservative consist of the highest grade of creosote oil.

Discussion of this paper will be found on page 244.

WOOD BLOCK PAVEMENTS WITH REFERENCE TO ECONOMIC AND EFFICIENT WOOD PRESERVATIVES.

By J. W. Howard, Consulting Engineer on Pavements, New York City.

Experience is the best teacher. Records of European and American cities of fifty years and the experience of living engineers during the past thirty years, show what wood pavements have and have not given economic and efficient results. New and relatively untried wood preservative oils or compounds should not be tried at public expense nor adopted for use until proven to be good. A specification should be a standard of enumerated qualities which all materials, good for the purpose, must meet; and not be a description in technical language of one special brand or product, to the exclusion of others, known by experience to be good, efficient, durable and economic.

Many engineers have seen specifications which are practically a secret description in technical and chemical language of one brand or product of paving material, without naming it or revealing the selfish interest controlling and promoting it. We have seen the omission of necessary tests and insertion of some special specific gravity, and limited distillation tests of preservative for wood paving blocks with numerical requirements, such that practically only one brand or group of tar-products could meet these peculiarities, several of the included requirements having nothing to do with the needed qualities of the oil. Such specifications may be a basis for promotion and political money influence, but are not a good basis for economic pavements and taxation.

Specifications originating from commercial or selfish interests must be carefully investigated. Many honest and informed city engineers have saved their cities from excessive prices for pavements by insisting on specifications being open to competition from equally good and often superior wood preservatives, likewise for other paving materials. Unfortunately, in some cities controlled by a political boss and venal public officials, it has not always been possible for a city engineer to prevent the use of an objectionable specification. This does not apply to a patent material or article when the patent is

previously made known, the material especially good for the location, the known price reasonable and just, and the city and all contractors can obtain the patented material at the same price.

It is the well recognized duty and policy of the American Society of Municipal Improvements to adopt specifications which shall be standards of excellence, expressed in the specification by physical and chemical requirements and tests, which fully show that the material, whether it be wood preservative or other, is good for the use intended; and such specifications must omit all chemical or other requirements which have nothing to do with quality, but which are descriptions and limit the material to one brand, or product, to the exclusion of equally good or better.

Many of us engineers know a specification descriptive of a tar product or tar-oil compound for wood pavement blocks, which has appeared in some important cities and been before this and other societies, which specification is a description, inserted as tests, put there to control or limit the special "tar product" to be used, to a pitch or tar containing oil, which practically excludes competition and prevents the use of good, long established, standard distillate creosote oils. This exclusion is accomplished by specifying a heavy specific gravity of 1.08 or heavier, combined with the requirement that the total distillates up to 315° C. shall not be more than 50% (or even 40%) and not forbid stiff, brittle residues; whereas some pure, good creosote oils yield as high as 85% total distillates up to 315° C. and some 95% up to 355° C. and have specific gravities both below and above 1.08, and have good, soft residues; as per tests of good types of excellent creosote oils of America and Europe given later in this paper and in reliable books of authority. Such specifications should be changed accordingly, so as to secure competition from more creosoting plants and paving contractors, and to obtain cheaper prices, better and more efficient wood pavements; all other requirements for the pavement foundation and construction being equal and good.

The set of tests for wood preservatives should be as few and as simple as possible, so as to be made in any good laboratory and easily understood by city engineers who are not chemists. All preservatives for wood paving blocks (and there are several good ones) should be insoluble in water; be able to thoroly impregnate the wood and thereby practically exclude water. The exclusion of water is

to prevent swelling of the blocks and buckling of the pavement; also to prevent fungus or germ growth which cannot exist without water in the blocks. Preservatives should have germicidal or antiseptic qualities. They should be stable and not have their essential qualities evaporate and leave the wood from the effect of the sun, air or other elements. They should not ooze or bleed out of the wood to any noticeable amount either from the heat of the sun or from the compression of the blocks, to a material loss of the preservative, or to thereby make a pitchy, dirty pavement, injurious to pedestrians, vehicles, floors and carpets of adjacent buildings, as occurs with tar products not creosote oils.

Beyond giving several types it is unnecessary for me to go into the details of the several good wood preservatives and the laboratory tests of them, because their descriptions and tests are found in old, standard, open specifications of many cities, and in chemical and engineering publications of the United States, Germany, England and France, easily obtainable in all large libraries.

Because of their comparative cheapness and abundance all over the world, by-product coal and gas-tars are the sources from which most good distillate creosote oils are manufactured for this purpose. Within a few years water-gas-tars have become the basis of manufacture of wood preserving oils which, alone or combined with coal-tar distillate creosote oil, give promise of successful economic results in wood preservation as laid under W. H. Connell, C. E., in 1912 on Arch St., Philadelphia. The Bethell process of wood preservation devised in 1838 for impregnating wood with tar distillate creosote, and many modifications and substitutions thereof, such as Labrot, Lowry, Card, Burnett and Rueping, have all been used for many years with success.

Creosote oils compose the group of the principal preservatives for wood; the best being always made by distilling tars and are not tar products or compounds of oils and pitch which are not distillates and are objectionable. U. S. Forestry Service Circular 206, page 9, shows that creosote oils are all distillates manufactured from many tars, stating it briefly in the following words: "The general process of manufacture is similar in all cases. The tar is distilled in a metal retort or still and the vapors are condensed and collected. Those distillates which are heavier than water form the true creosotes used in wood preservation. The temperatures at which the creosotes are obtained vary greatly, but generally lie between about 200° and

360° C. The actual temperatures in each case depend largely upon the character of the residue desired."

The *best creosote oils* are, therefore, all *distillates. A good and efficient specification admitting all good and excluding all poor creosote oils for wood paving blocks should require as follows:* The preservative used must be a distillate creosote oil of above 1.03 sp. grav. at 38° C. (100° F.), containing less than 1% of matter insoluble in benzol by hot extraction. It shall be waterproof, antiseptic, containing at least 10% of crystallizable napthalene, and at least 15% of the stable anthracene oil. When distilled as described in Bulletin No. 65, American Railway Engineering and Maintenance-of-Way Association, the total distillate on basis of water-free oil up to 150° C. (302° F.), shall not exceed 1%; the total up to 200° C. (392° F.) shall not exceed 5%. The distillation shall be continued to 315° C. (600° F.), and the residue then remaining, when cooled to 25° C. (77° F.), shall be soft and easily indented with the finger. The creosote oil used shall be a distillate made from coal-tar or a combination of distillates from coal-tar and water-gas-tar; provided the oil produced meets all the above tests of qualities needed for thoroly preserving wood. All such creosote oils contain enough napthalene to be germicidal and prevent decay of wood. They also contain a large amount of anthracene oil which is waterproof, stable and cannot be volatilized or injured by the elements and being heavier than water is not floated out of wood but remains, excluding water which is the vital enemy of structural wood.

The high grades of true, distillate (pitch free) creosote oils, used in the minimum quantity needed, even as low as 14 lbs. per cubic foot of wood, and thoroly impregnating it, do not ooze from the wood blocks, as do the impure compound oils containing any appreciable amount of pitch (the stiff, hard part of crude tars); even when such compound oils are used in as small quantities. The pitch-containing oils do not generally thoroly impregnate the wood and often contain other impurities affected by water and the elements in hot, cold or wet weather.

The citizens want clean, handsome street pavements from the beginning. We must not permit dirty, pitchy, tarry pavements, when it is possible, as shown by long experience in all countries, to construct wood pavements which are and remain clean from the start. Imagine any person trying to persuade Paris, Berlin or London to replace their clean, good wood pavements, with a kind which

would be covered with oozing, bleeding tar in warm weather, or to persuade Boston to do so on the part of Tremont Street, where a clean wood pavement has been in use for more than twelve years, or Baltimore to substitute the tarry kind for its long used, clean wood pavements, still in good condition. The continued success I have personally observed during the past thirty years, of clean, good, durable wood block pavements, in Berlin, Paris, London, Tremont Street Boston, lower Broadway New York, certain streets in Baltimore, Chicago, St. Louis, South Bend, Toledo and elsewhere, have long since convinced me and many others that there is no need of abandoning that which is good for that which is tarry, and to say the least not more durable.

A specification for wood block pavement should be such as to enable a city to have durable wood pavements where needed and to assure competition and lowest possible cost; and to use any kind of wood block pavement which had already shown itself successful in any city. No specifications should exclude wood pavements which have proven themselves to be durable, efficient, successful and in good condition in actual use for a period of ten or more years, under severe climatic conditions and heavy, numerous traffic. The above safe, open, single, comprehensive specification is the best and would permit competition and the use of every one of the good distillate creosote oils which have been successful. Such genuine distillate creosote oils of commerce are obtainable from many competing sources in America and Europe, and can be easily manufactured from all tars in small plants by anyone desiring to do so. The best creosote oils are not controlled thru patented processes nor thru by-products of patented processes of coke or gas manufacture, nor by any trust or business combination.

One of the best descriptions and requirements for good creosote oil is that adopted by the American Railway Engineering Association as recommended by committee XVII on wood preservation, composed of Messrs. Stimson, Bowser, von Schrenk, and nine other members, as follows:

"*Grade 1 Coal Tar Creosote,* referred to also as Maintenance-of-Way-Oil No. 1. The oil used shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal gas tar or coke oven tar and shall be free from any tar, including coal gas tar and coke oven tar, oil or residue obtained from

petroleum or any other source; it shall be completely liquid at thirty-eight (38) degrees centigrade and shall be free from suspended matter; the specific gravity of the oil at thirty-eight (38) degrees centigrade shall be at least 1.03. When distilled by the common method—that is, using an eight (8) ounce retort, asbestos covered, with standard thermometer, bulb one-half (½) inch above the surface of the oil—the creosote, calculated on the basis of the dry oil shall give no distillate below two hundred (200) degrees centigrade, not more than five (5) per cent below two hundred and ten (210) degrees centigrade, not more than twenty-five (25) per cent below two hundred and thirty-five (235) degrees centigrade, and the residue above three hundred and fifty-five (355) degrees centigrade, if it exceeds five (5) per cent in quantity, shall be soft. The oil shall not contain more than three (3) per cent water."

The committee, Proceedings Vol. 15, page 632, further stated: "Whenever possible only Grade 1 Coal Tar Creosote should be used, and under no circumstances should coal tar be added to creosote of this grade."

In Appendix A, by Dr. H. von Schrenk and A. L. Kammerer, page 680, they state: "The writers firmly believe that the best results with creosoting will always be obtained by the use of oil equivalent to the American Railway Engineering Association No. 1 oil. * * * The practice which has come about in various quarters of selling creosote oil mixed with coal-tar as a No. 1 specification oil, should be stopped; and where No. 1 specification is called for, that the specification for such oil, as printed in the Manual, be rigidly enforced."

As examples of good types of competing commercial creosote oils, all distillates, it is interesting to note the following specific gravities at 38° C. (100° F.): American 1.034, another American, used at Chicago, 1.109; these two having total distillates up to 358° C. (671° F.) of 91 and 70 per cent respectively, and having residues left which are soft and of dark amber color. German creosote oil, specific gravity 1.064; distillate up to 355° C. 80%, leaving soft residue. English creosote oil, specific gravity 1.044, total distillate to 355° C. 90%, residue soft. I note for comparison the pitch mixture or pitch containing oil, not a distillate, which has been used

for a very few years in some cities of the United States but is not as good as real creosote oils, that it had a gravity of 1.115, total distillates up to 355° C. of 61%, and that the residue then remaining was hard, stiff, brittle pitch. This pitch tar oil compound had 3.1% insoluble in hot benzol by the extraction test; while the creosote oils have less than 1% thus insoluble.

Wood pavements have their limited but proper place especially on some interior business streets of large cities; altho for the vast majority of streets of all cities, other kinds of pavements, each in its proper place, are more suitable and less expensive.

German efficiency says, "Siehe Alles und behalte das Beste" (see all and retain the best). The English adage says, "Do not remove old land marks." Therefore we must not abandon the use of the kinds of wood (or other pavements) which have succeeded, but retain their specifications and repeat those successes on our streets. I hold no brief for any wood paving interest or material. I speak entirely from the standpoints of public welfare and good professional ethics in engineering. The city engineers and officials of this Society certainly agree with me that we must resist commercialism and selfish politics and be wholly governed by that which is best for the interests of the taxpayers, cities and the nation we serve. In other words, we should be loyal and patriotic in times of peace and not reserve our patriotism for times of war.

DISCUSSION

Of Papers on Wood Block Treatment and Paving.

Mr. Reilly: I woud like to ask Prof. von Schrenk a question. He referred to the fact that the specifications that he mentioned were adopted by the American Railway Engineering Association last Fall.

Mr. von Schrenk: No, sir.

Mr. Reilly: Well, then perhaps I misunderstood you. I want to ask this question: Did the Engineering Association say if you admix tar with the creosote oil it would be a No. 1 specification, or their No. 2? Did the American Railway Engineering Association say if you admix tar that you must not add more than 20%, and that if

you did, that that must be included in their No. 2 oil, or No. 3 oil, or some other? Did they allow you to add tar to their No. 1 Maintenance-of-Way-oil, and pass it as No. 1?

MR. VON SCHRENK: If you will kindly refer to the Manual of the A. R. E. A. you will find there what they did.

MR. REILLY: I have the Manual right here, and the Manual says you must not admix tar to the oil of their No. 1.

MR. VON SCHRENK: It does not say that you "must not."

MR. REILLY: Yes, it says you must not. If you add tar to the creosote block specification, it makes it a No. 2 specification. If you add tar to the creosote oil in the wood block specification under the very ambiguous term "coal tar product," you should specify the kind of oil, the kind of tar, and the percentage of oil and the percentage of tar to be used by the specification. You should define absolutely what your specification is. If it is to be a No. 2, say so; if it is to be a No. 1, say so. The Railway Engineering Association say if you admix tar with the oil it is a No. 2 specification.

MR. VON SCHRENK: I beg to differ with Mr. Reilly on that, as I happened to be the chairman of the sub-committee which had that specification under consideration.

MR. REILLY: Well, I have the Manual here, and I can go to my room and get it for you, if you wish.

MR. VON SCHRENK: The American Railway Engineering Association until last year had one specification on creosote oil, which it called a standard. It was found, just as it is in the countries of Europe, that oils are made from various kinds of materials; they have different analyses, and they have different distilling points. We found, while all would like to purchase oil on a No. 1 specification, i. e., having 25% distillate at 235, which was the lowest amount allowed, that a great many were obliged to purchase oils of a different character because enough of the standard was not available —there was not enough to go around. As a result of the general feeling of the railway engineers, the committee was instructed to

formulate a specification for oils which were slightly inferior to the extent of having a greater per cent of distillate at 235° C. The following year the committee brought in a recommendation that we should make three grades of oil, and those grades of oil were called No. 1, No. 2 and No. 3, No. 2 having a 30% distillate at 235° C., and No. 3 having a 45% distillate at 235° C. The time then came when a small percentage of refined coal tar was first mixed by the railway companies at their plants, and I can speak authoritatively on that because I think I was the first officer of an American railway that did that. Considerable difficulty was found in the mixing at the railroad plants, and a committee of railway engineers then, after an investigation of over two years, finally brought in a standard specification that was called a coal tar creosote solution. It said in its recommendations to the Association that a coal tar should be added preferably to oils No. 2 and No. 3. It did not enforce the specification on anybody, that you should not add it to No. 1, if you wanted to, but advised the adding of coal tar to creosotes No. 2 and No. 3. The coal tar creosote specification has no number to it. It is called, frankly, a specification for a coal tar creosote solution. We did not define the percentage of coal tar, and did not define the percentage of creosote, for the obvious reason that we did not care very much about that, but specified a compound conforming to certain specific gravities. I am going to strongly recommend next year that we adopt the recommendation of your committee, and add one or two clauses to make that a very much higher specification than we have. The chief reason for the various specifications was an adaptation to oils available. And in spite of what anybody may say, it will have to continue because the supply of oils in this country of a high grade is insufficient to meet the ordinary demands in this country at the present time.

Mr. Sherrerd: I would like to ask Mr. Reilly if he can tell us what the increased price per square yard on the same pavement would be if treated with the oil which he recommends as the best for this purpose.

Mr. Reilly: Well, the cost, using about five gallons to the yard, would be about 60 cents per square yard; an increase of twenty cents per yard above commercial creosote oil, if the same quantities are used.

MR. SHERRERD: In our experience, with the use of the specification that has been presented to this Society good results have been obtained with a lower priced pavement.

MR. REILLY: They have not given good results at all.

MR. SHERRERD: They have in many places.

MR. REILLY: The troubles from creosote block pavement have been due to the use of the material—the use of the tar mixture.

MR. SHERRERD: Due to what? The failure has been due to what? I didn't understand you.

MR. REILLY: Due to the use of the tar mixture specification. There are cities, many of them, that now exclude the use of creosote block, and it is simply because under that specification they did not get a suitable pavement.

MR. DOW: How have they failed?

MR. REILLY: They have failed because it was discovered that the blocks treated with a tar oil bulged so badly that the curb was so pushed out of line that it had to be replaced, and because of this bulging, people, animals, and vehicles suffered injury; and further injury was caused by the exuding tar being carried into homes and stores.

I would like to state one thing more. One of the greatest troubles with the creosoted blocks treated with tars has been the destruction of rugs in people's homes, and in stores. I am confronted with that regularly. The exuding tar from the blocks has caused greater destruction in homes than the cost of the paving. There are evidences of that in almost any city where a tar block pavement is found. It is not confined to any one city; it is to be found in many cities.

MR. DOW: I have here photographs taken by the present engineer of the city of Dayton of pavements laid with blocks treated with Mr. Reilly's distillate oil. Here is Rose Hill and Beechwood avenue, taken in July 17, 1910. It shows that these blocks, treated with a

heavy distillate oil, have exuded, have bled, and are so covered with the ooze that it was tracked into people's houses, and they complained about it. A portion of the street—

MR. REILLY: Mr. Dow, that is not so. You know that that oil was never made in Mr. Reilly's plant. You were the inspector.

MR. DOW: This is a distillate oil, wherever it was made, and Mr. Reilly says it complies with his specification which he is now recommending. Here is a photograph of the Reading Road in Cincinnati, taken in 1911. The oozing from the blocks was so fierce that it was tracked onto a granite pavement next to it so that the granite pavement is all spotted up.

MR. REILLY: Did Mr. Reilly make that oil?

MR. DOW: I do not know who made the oil, but it complies with the specification.

MR. REILLY: If you know who made the oil you should state that fact.

MR. DOW: I don't know anything about who made it.

MR. REILLY: You were the inspector, weren't you?

MR. DOW: No, I was not.

MR. REILLY: Well, you knew about it!

MR. DOW: I have numerous photographs of that kind, which show the action of distillate oil in wood blocks. I also have photographs taken in the city of Chicago this year, and I also inspected them personally two or three weeks ago, and they were covered with a mass of the ooze on the top of the blocks, and property owners complained of the fierce bleeding to their aldermen and requested the placing of sand on them to prevent this being tracked into the stores during hot weather.

MR. REILLY: If Mr. Hittell were present he could best answer as to the condition in Chicago. Prior to the adoption of the present specification, and when the city was using the tar mixture specifica-

tion, there was a great deal of complaint because of the exuding tar. The papers there reported people being stuck in the street in the tar and the great destruction of rugs in stores abutting these pavements. Since the adoption of this oil there has been no such trouble and there has been no complaint in the City Hall.

MR. SHERRERD: Speaking as one of the Committee on Standard Specifications, which has been wrestling for more than two days with this very question, it seems, to me at least, that where the doctors differ to such a great extent it is likely that the patient will die, unless we can arrive at some intermediate point. Now, the committee will present to-morrow a tentative form of specification, which is practically a mean between these two extremes which have been presented here to-night. Mr. Reilly's plant furnished blocks for Broad Street in Newark, under specifications which called for the use of tar, but not what they call the tar product creosote, and it is giving very satisfactory results. I have heard at least a dozen delegates to this convention say that they thought it was the best wood block street that they had seen. The blocks did bleed during the first year after they were laid, but not very extensively. One reason why, in my judgment, they did not bleed very extensively was because the blocks were entirely immersed in water for ten minutes immediately before they were laid. They were, therefore, laid at their expanded lengths. If you will remember the sections of wood fiber which Mr. Reilly threw upon the screen I think you will be able to follow me as I describe what, in my judgment, and what I have been informed by people who have studied the question further than I have, to be the fact, that the outline of the cell is rather crinkly in shape. You noticed the oval of those cells, and the irregular shape of the oval. In any of these treatments with the creosote oil, it seems that the cell does not materially change its shape, but that immediately upon being soaked in water,—and this 10-minute submersion seems to bring it about—the cell takes a cylindrical shape and expands the block. Now, I believe that that has, to a very large degree, prevented the bleeding, and I am beginning to believe that we have been giving too much attention to the specific gravity, perhaps, or to the quality of the oils, and that this question of treatment and the question of the method of laying the block has much more to do with satisfactory results. It seems to me that to pay an added price of 25 per cent for the use of an oil, which is the view of an extremist in this treatment

process and the view of the manufacturer of that oil, is out of the question. I do not mean any reflection on the concern presenting that view, because I believe Mr. Reilly knows what he is talking about, for he has convinced me of that fact in several conversations I have had with him. I also believe he can manufacture good block with almost any of these oils. Therefore, I think there is a happy medium, and if the other members of the Committee on Standard Specifications who are present at the convention agree with me, I suggest we present for your consideration, at least for use this year, and until we can go further into the matter, a specification which, as I said before, would be somewhat of a mean. It will reduce the specific gravity to 1.06 and calls for oils running from 1.06 to 1.12, and it will provide for 35 per cent addition of tars; for the reason, as represented to us, that this will be a step in the direction of getting those who are interested in this question and in the treatment of the blocks to agree on the use of this specification as being such a mean as would be applicable all over the country.

MR. HORNER: May I ask Mr. Reilly how long this type of oil which he recommends has been in use.

MR. REILLY: I have read from an article of Lunge on "Coal Tar," published in 1887, where this type of oil had then been in use for years prior to that date.

MR. HORNER: How long has it been used in this country?

MR. REILLY: It has been used in this country very nearly that length of time.

MR. HORNER: What is the specific gravity of that oil?

MR. REILLY: I don't know just what the gravity of the oil used years ago was, but I believe it was about 1.08 to 1.12.

MR. HORNER: How long has it been used in paving block, Mr. Reilly, this particular oil?

MR. REILLY: Well, that I don't know. I am not familiar with the oil used in Europe, but—

MR. HORNER: I mean, in this country?

MR. REILLY: Well, I would say probably in a large way the first oil was used in the city of Chicago, probably four years ago.

MR. BARLOW: Did you use in Cincinnati the same specifications?

MR. REILLY: Which one is that?

MR. BARLOW: On the oil that was used on the Reading Road.

MR. REILLY: On Rose Hill and Beechwood? That I don't know.

MR. BARLOW: It was under the same specifications.

MR. REILLY: They were not the same specifications.

MR. BARLOW: They were both furnished by you.

MR. REILLY: The blocks were evidently furnished by me, but I did not manufacture the oil.

MR. TRIBUS: I think that is something that we can lay out as an equation: Whereas ten or fifteen years ago good blocks were laid at a price around three dollars a square yard, which did not bleed, which did not blow up, which did give good service, and whereas in the last five years block pavements at $2.25 a square yard do bleed, do blow up, do not give satisfactory service, therefore, there was something in the manufacture of the blocks ten or fifteen years ago that was better than the manufacture of the blocks to-day. Now, what was it? Was it the oil that went into them? I do not believe it was solely.

MR. VON SCHRENK: I think the answer to the question is in the treatment of the blocks.

MR. STERN: It is very desirable that there be thoro discussion on this question, as it should have an important bearing on the future of wood block pavement. In the Boro of Manhattan of the City of New York, no contracts for wood block pavement were made in the year 1915, owing to widespread dissatisfaction on the part of citizens with existing wood block pavements.

So many complaints had been received regarding the nuisance caused by the "bleeding" of the blocks and their slipperiness that it was decided to send circular letters to those who, by the nature of their business, were directly interested in the question of the type of pavement, namely, to owners of trucks, both horse and motor driven, to express companies, to wholesale and retail stores, associations, etc. This letter was as follows:

"In order to ascertain the views of those who use the streets of Manhattan, this department is asking owners of motor and horse vehicles for the following information:

1. Which type of pavement do you prefer most for your business?
   (a) Improved Granite—similar to that on Lafayette street.
   (b) Wood Block.
   (c) Sheet Asphalt.
   (d) Asphalt Block.
2. Which of the above pavements do you least prefer?

A prompt answer will be appreciated."

Replies were received from 49 people. The majority was opposed to the use of wood block on account of its being slippery and therefore dangerous both to autos and horses. A strong letter was received from the Society for the Prevention of Cruelty to Animals, as follows:

"Replying to your communication of the 16th inst., in re pavements, this Society desires to state that the type of pavement it most prefers, for animals, is the improved granite, similar to that laid on Lafayette Street, Fulton Street, portions of Fourth Avenue and other places.

"The kind of pavement the Society least prefers—in the best interest of animals that have to use the pavements—is the wood block. This latter pavement is most treacherous and slippery, under the atmospheric and climatic conditions which prevail, and has caused more accidents to horses on the streets of our city, in our judgment, than all of the other smooth pavements combined.

"The opinions above set forth are based on the observances and experiences of this Society, covering a period of many years.

"Trusting they will be sufficient for your purposes, we are, etc."

The expressions of opinion as above, taken in connection with many complaints of property-owners, objecting to the "bleeding" of the blocks, were considerations which could not be ignored. It was therefore decided that until a method of treatment for creosoting wood blocks was developed which would eliminate the above objections, no bids would be asked for wood block pavement.

A wood block pavement has unquestionably great possibilities in cities, and this society can render valuable service to both the public and the wood pavement industry if it can make recommendations which will eliminate or minimize the following existing defects: 1. bleeding; 2. excessive slipperiness; 3. bulging.

A MEMBER: Mr. von Schrenk has spoken of the very thoro examinations made of paving blocks in this country, and has evidently drawn the conclusion that one of the chief troubles with wood block pavement has been the lack of a proper mechanical treatment at the plant. Undoubtedly this is true. He has said that the examination of blocks treated with water gas tar showed blocks in the street that did not have proper treatment of the sapwood, which is a condition that will occur with any type of oil, when the proper treatment is not given. I am speaking for a company which maintains a supply of these different types of creosoting oil, a straight distillate oil, a coal-tar distillate oil solution, and the refined water gas tar. We do not feel that a specification should be drawn which will prohibit any city calling for water gas tar if it so desires, especially in view of the fact that it has been our experience to furnish customers water gas tar for over 500,000 square yards since 1908; and an examination made in 1914 of a considerable part of that yardage shows that a great many of those streets have been in use from 1908 without repairs of any kind, and the streets are in as good condition as the day they were laid, excepting the mechanical wear of the surface. The nearest piece of work of that kind that I know of is on the bridge over the Allegheny river at Pittsburgh, laid in 1908. We can furnish a list of a great many of these streets and a thoro investigation will bear out the reports we have received from the city officials under whose supervision the work was done. I do not know whether the modified specification which the committee will recommend to-morrow will admit water gas tar or not. As shown in its first draft it did not. Now if you specify the oil furnished by one company you will have competition but the competition will be from one standpoint only;

but if you specify three different kinds of oil, you are getting competition of the purchaser as well as the creosoter and the contractor.

MR. CHERRINGTON (by letter): In reading Mr. Ellis R. Dutton's paper entitled, "Some Experiences in Creosoted Wood Block Pavements," one can not help but note the emphasis he places upon the importance of injecting into such materials not less than 16 pounds of creosote per cubic foot of timber.

Exception should be taken to this particular conclusion. The failure of certain individual blocks to which Mr. Dutton refers, was undoubtedly due rather to the improper method of treatment, resulting in an incomplete penetration, or poor diffusion of the preservative creosote oil, than to an insufficient amount.

There are many instances wherein wood blocks impregnated with 10 pounds and 12 pounds of creosote per cubic foot of timber have successfully resisted decay over a long period of years. Creosoted block pavements abroad, rarely, if ever, are treated with more than 12 pounds of creosote per cubic foot of timber. The oldest wood block streets we have in this country were similarly treated, and many of these to-day appear to be good for at least another 16 years' service, without the necessity of maintenance charges.

The amount of injected creosote oil was first increased above 12 pounds in this country, not for the purpose of more efficiently retarding decay, but because it was thought that additional quantities would make the blocks more nearly waterproof. However, experience has shown that the existence of large quantities of preservative oil in the blocks will not consistently control, or prevent, their possible destructive expansion.

Therefore, as heavy treatments of 16 pounds and 20 pounds of creosote oil do not accomplish the waterproofing function for which they are injected, engineers are returning to a standard injection of 12 pounds per cubic foot of timber for the purposes of preventing decay only.

Methods of treatment used for creosoting wood blocks 15 years ago have practically become obsolete, inasmuch as it has been repeatedly demonstrated to be impossible to obtain by them a good penetration, or diffusion thruout the blocks, even tho excessive quantities of oil are injected.

Modern creosoting processes provide an even resistance against the gradual absorption of the preservative being forced in under pressure. This resistance is created by equalizing the moisture contents of the blocks by the admittance of live steam followed by the application and retention of a vacuum.

In some instances an initial injection of air is provided under a considerable pressure to serve as a uniform resistant cushion in every fiber of the wood, against the penetration of unequal quantities of preservative; at the same time the initially compressed air prepares an easier opening for the more complete penetrance of the preservative oil.

Modern creosoting processes permit an adequate diffusion of 12 pounds of creosote per cubic foot of timber thruout the volume of the blocks. Therefore, the life of any wood block pavement so treated will be indefinite, so far as the preservation of the pavement from decay is concerned.

THE MAINTENANCE OF PAVEMENTS.

By JACOB L. BAUER, County Engineer, Elizabeth, N. J.

In the consideration of modern pavements from the standpoint of their maintenance they may be grouped under three headings, as follows:

(1) Stone Block, Brick, Asphalt Block, Wood Block, etc.

(2) Concrete and Bituminous Concrete.

(3) Macadam, either with or without surface treatment. Gravel Roads, etc.

The pavements comprised in the first group are made up of small individual members and repairs and maintenance are usually easily made by replacements with new members or by the readjustment of the old members. Failures in these pavements may be due to many causes, but by far the largest percentage are due to poor individual members of the paving surface, shifting of sand cushion, previous trenching work in the street, the movement of street car rails, and settlement by reason of poor foundation. In the case where poor foundation is responsible the fault lies with the original construction of the pavement and there are many cases where an expensive street surface deteriorates in a few years thru bad foundations with a resultant large waste of money. I have no plan to suggest for the maintenance of the pavement with a poor foundation other than to rebuild the old pavement from the bottom, first putting in a good foundation. Failures of the paving surface in these pavements should be repaired at once, as neglect means a greatly increased outlay of money within a short period in order to make repairs. Ordinarily these repairs if done in time cause no obstruction to traffic excepting in cases where a section of new concrete base must be laid. The placing of this concrete is sometimes an annoying and costly job as it must be protected for a week or more before traffic can be allowed to go over it. It seems to me that it might be possible in these cases to use a bituminous concrete for a foundation which would set up at once and permit of the street being opened the same day the repair is made. I am not aware that this plan has ever been followed, but it suggests itself to me as a feasible plan. Where pavements of this class show extraordinary wear, as street

intersections, etc., it is always best to make immediate repairs over the area affected. Where replacements of these pavements are made in locations where the operations inconvenience the traffic, as in front of business houses, etc., some time is saved by using asphalt or tar joints instead of cement mortar joints, as the tar or asphalt joints set up very quickly. Municipalities should always keep on hand a sufficient quantity of the special materials of which these surfaces are made, so that quick repairs may be made as and where necessary.

Where street openings are made in such pavements and indeed in any pavements for the purpose of laying gas, water, sewer or other pipes or conduits, the companies and individuals making such openings are sometimes inclined to be lax in taking care to make proper replacements. This difficulty has been cured in the county where the writer is the engineer by requiring the deposit of $25.00 for each opening. In the case of plain macadam the depositor is required to replace the same and keep it in order and the deposit is returned three months after the opening is made, providing the street surface is then in good order. In the case of pavements other than macadam the county makes replacements of the surfaces and charges the cost thereof against the moneys on deposit. Water companies and others are permitted to deposit $100.00; in return for which act, any number of permits are issued to them. This plan has had very beneficial results and we now have no difficulty whatever with the replacement of the pavement over such openings. On roads having pavements of 20 feet width or less, the small gas and water service pipes may generally be driven across the roadway thus doing away with the necessity of removing the roadway. This cannot be done, of course, in rocky soil. No tunneling should be permitted in paved streets for the purpose of laying pipes or conduits unless there is at least 6 feet from top of pipe to street surface. In trenches that are from 6 feet to 10 feet in depth the tunnel should not exceed 16 feet to 20 feet in the clear of openings.

The pavements of the second group are the most difficult to maintain and repair. Concrete pavements are increasing in number in a wonderful fashion. They are good pavements and furnish good value for their cost, but they have the fault of cracking. This fault may be due to a variety of reasons and I think that possibly all reasons have as yet not been discovered. A concrete pavement which is not of precisely the same hardness thruout, might thru the winter season be the cause of a crack. Bad under-drainage is also

a fertile cause of cracking. The expansion and contracting of the pavement due to heat and cold will cause cracking under certain conditions. There are other reasons for this fault, some entirely local. A crack in a concrete pavement is not of itself a serious matter, as it is unnoticed under traffic and is easily and cheaply repaired. The repair, however, is made by pouring into the crack tar or asphalt, which spreads over the surface at each side of the crack and creates a bad appearance. This one point is that which is most often urged against the use of concrete pavements and I would suggest that the able engineers of the Cement Manufacturers' Association devise a material for the purpose of repairing a crack in a concrete pavement which will be of a color similar to that of concrete. If this were done I think that a very large part of the objection to concrete pavement would disappear. A disintegration of a concrete pavement due to poor material or extraordinary wear will ordinarily require the removal of the entire section or slab and the replacement with new material, if the appearance of the work is to be properly maintained. In the repair of bituminous concretes with hot mixed materials, a heating plant is required. I have had success, however, in repairing hot mixed pavements by the use of cold mixed materials. Where municipalities do not own mixing plants for hot mixed pavements the method of repair by using cold mixed materials is very much cheaper. In all cases where repairs are made in bituminous concretes the old material should be cut away entirely to a vertical face and the face should be painted with a heavy asphalt before the hole is again filled up with new material. In making these repairs with cold mixed materials it is frequently possible to do the work without the use of a steam roller, by leaving the patch a half inch or so higher than the surrounding pavement and then allowing the traffic to pound it down.

On heavy traveled roads having bituminous concrete pavements less than 24 feet in width, trouble will frequently be experienced with the breaking away of the edges of the pavement, and also with the formation of a vertical step several inches down at the edge of the pavement where the adjoining earth is gouged out by the traffic. This situation has frequently been met by the construction of a concrete shoulder at each side of the pavement from 6 inches to 12 inches in width and from 12 inches to 20 inches in depth. The concrete shoulder will cure the first of these two troubles, but not

the second. I think that the best method of cure is to widen the pavement to the full used and required width for the traffic.

Pavements of the third group are easily repaired and are easily maintained where light traffic obtains. Under heavy traffic, however, I regard any sort of a macadam road surface as only temporary and would keep it up as well as possible until such time as it could be resurfaced with bituminous concrete or replaced with a better class of pavement. In repairing a macadam road the holes should first be filled up level with the general surface with crushed stone. If the depressions are many they should be rolled before a new top is applied, which may be from 2 inches thick to 6 inches thick and compacted in the usual manner. The public is now educated up to the point where an old-fashioned dusty macadam road surface is very objectionable and I am a strong believer in the economy and advisability of the application of a tar or asphalt surface treatment to all macadam roads, as such treatments tend to preserve the surface while also laying the dust. Such treatments are to-day very low in cost. In the maintenance of gravel roads the procedure should be the same practically as in the case of macadam roads. I believe that a surface treatment of bituminous or other binding material applied to a gravel road will also be found to be economical, as it would keep the road bed from disintegrating, and lay the dust as well as doing away to a certain extent with the necessity for repairs.

In the maintaining of ordinary macadam work on main highways I am a believer in the patrol system, by which one man covers a certain territory, keeping all holes and depressions filled up, draining off standing water, cleaning out gutters, etc. I have found this system to be cheaper and very much better than any other in the care of macadam roads.

Every writer on this subject has called attention to the point that repairs to any roadway should begin as soon as needed, which in most cases is within the first year of their construction. Yet it is a fact that we still see many examples of wanton neglect in the care of pavements, frequently in municipalities that might be expected to know and do better. In the matter of repairs and maintenance a road may be likened to a building. For instance, what municipality would think of erecting a $100,000 schoolhouse and then not spending a cent on it for repairs and maintenance for fifteen or twenty years? Under those conditions at the end of the period, the

building would very likely be untenantable. Yet many municipalities spend large sums on roads and then do nothing to keep them in order, thereby losing outright a large part of their original investment.

On all roadways where the pavement does not extend from curb to curb the gutters should be cleaned out and regraded thruout once each year. Any hip or shoulder in the side of the pavement which may form higher than the pavement should also be removed and any depressions filled in so that the water will get into the gutter where it belongs.

The question as to what constitutes heavy traffic and light traffic is not definitely settled and there are many opinions as to what these terms mean. It is my opinion that not enough importance has been placed on swiftly moving traffic, as against slow moving traffic. For instance, there are many small towns and cities where the plaza about the railroad station is paved with ordinary macadam. The traffic over this pavement may be greater in number of vehicles per day than any other street in the city. It is, however, slow moving traffic and the result is that the macadam pavement will remain in very fair order for long periods without very much repair. Take the same vehicles and run them swiftly over a 16 feet wide country road built of macadam and the result will probably be the disintegration of the macadam surface so that it is in bad shape for nearly all the time. Thus on residential streets that are not thorofares it may very often happen that a macadam roadway treated with a surface binder and dust layer will furnish a good driveway and may be maintained at a very small expense, even tho there is a considerable traffic, including even heavy traffic.

It is my opinion that a main county road paved say for the width of from 16 feet to 20 feet and carrying a maximum traffic of 2,000 vehicles in 24 hours running at high rates of speed, receives a much greater pounding and a much greater wear than a main city street carrying twice the number of vehicles per day. This question of traffic, slow moving and fast moving, over city streets and county roads has not as yet been worked out on a basis that has any great value in the determination of kinds of pavement to be used.

PAVING MAINTENANCE FROM THE STANDPOINT OF ITS RELATION TO THE ECONOMICAL FEATURES.

By R. A. MEEKER, State Engineer, Department of Roads, Trenton, N. J.

Road maintenance comprises the removal of the matter worn out by the action of the traffic and the weather, the care of the surface and of the drainage, and such casual repairs to the road and its appurtenances as may be necessary.

The most obvious of these is the application of new material, but the prevention of avoidable wear, by keeping the surface and body of the road in good condition, is hardly less important than the removal of worn material and the care of drainage.

Experience proves that a road with sufficient strength, good surface and thoro drainage can be kept in first class order with a much smaller quantity of materials than an inferior, ill-kept road requires. In brief, a good road is more cheaply maintained than a bad one. It is evident that the maintenance of a road already in good condition and of sufficient strength, if properly carried on, is almost entirely a question of wear. With greater traffic or softer material the wear will be faster but with good maintenance there need be no deterioration.

The problem is to reduce the wear both from traffic and the weather to a minimum and to substitute other materials for those worn out.

DRAINAGE: Proper care of the surface is generally all that is wanted to prevent water standing upon the road or in the gutters, but a dry surface is not enough. On a flat, water may often be seen standing in the ditches and gutters; in which case the sub-soil and the coating must necessarily be softened by the soaking of the water, which is often carried up eighteen inches by capillary attraction. This water is retained under the road long after that in the ditches has subsided and its bad effect is frequently not manifest until the adjoining ground is dry. With bituminous surfaces this is even more so, owing to the air-tight character of the pavement. These conditions demand a deeper ditch, a larger drain, a larger or a new

culvert, or a drain cut thru adjoining land. The ultimate economy of this work is beyond question as it removes a cause of great and growing damage to the pavement. Springs under a road and surface water from side hills, if cut off by under-drains, save many times their cost. On waterbound macadam and gravel roads the coating may often be improved in composition and made harder by scraping, and a good surface may be had under almost any circumstances by proper attention to it. The influence which a good surface has in keeping down wear is greater than is supposed with materials of all kinds but especially with those that are weak. A thin, light road is always expensive. Everything should be done to make a road strong enough to bear the traffic without cross breaking.

There is nothing more neglected than the removal of worn out materials from a road. From twenty per cent to twenty-five per cent of material on a macadam or gravel road will pass a 10-mesh screen. If this is exceeded the road will be soft, easily damaged by traffic, water and frost and wasteful of material.

A sufficient quantity of manual labor is necessary for the proper laying of road materials of whatever character. Much valuable material is often wasted because of an insufficient supply of labor at the proper time.

The economical advantage of having men in charge of certain lengths of road cannot be too much insisted on. Even if a man is not constantly employed on the surface work he becomes familiar with the peculiarities of his section and with the best way to treat them, and he soon learns to take a pride in his road. It is impossible to expect the same skill and industry from men employed by the job. Personal pride in his job will make a man do far more than mere wages.

Unfortunately, expenditure on road maintenance has often to be reduced below what is desirable, to the end that it may not exceed the amount available. Then the utmost skill and judgment must be exercised, to the end that the limited sum may be used to the best advantage. Labor must be reduced in order that sufficient material may be applied, else the road will be weakened until rebuilding becomes necessary; therefore, in more favorable times a reserve of material may be applied, thus strengthening the road and lessening the wear, and thereby lengthening the life of the road.

Care in the preparation of estimates and in accounts of actual expenditure on different roads year by year and a careful account of the quantity of material spread year by year on each road are essential to systematic road maintenance. Comparison of traffic and wear are much easier than absolute measurement and it is by such comparison and records of quantities of materials used and of expenditure for labor on various roads that an opinion must generally be formed of the economy with which they are maintained and of the requirements of any particular road. Due allowance must, of course, be made for difference in materials, situation and other conditions, and regard must be had to the condition in which roads are kept, but when comparisons are made over considerable areas they are less influenced by minor differences.

MUNICIPAL INSPECTION METHODS IN THE BORO OF MANHATTAN, NEW YORK CITY.

By FELIX KLEEBERG, Chemist, Department of Public Works, Boro of Manhattan, New York City.

The inspection force employed in the supervision of roadway construction in the Boro of Manhattan, New York City, consists at the present time of 138 men, responsible to and directed by the Chief Engineer of Highways. This force is divided into:

50 Inspectors of Regulating, Grading and Paving;

46 Inspectors of Public Works;

10 Junior Chemists;

32 Corporation Inspectors.

The men comprising the first two groups may be assigned either to street paving as such or to patrol duty. In the former case they are unofficially known as Roadway Inspectors and inspect either construction work or repairs. In the latter case they patrol a certain district, reporting defects in pavements needing repairs due to wear and tear, bad depressions, cave-ins, openings of various kinds, etc., and are known as Patrol Inspectors.

The Inspectors of Public Works may be assigned to other duties besides roadway construction if circumstances demand and warrant.

The Junior Chemists are assigned to the contractors' asphalt plants and are unofficially called Plant Inspectors.

The Corporation Inspectors supervise cuts, openings and repairs made by gas, electric, street railway and other corporations.

The men comprising the first three groups are appointed after competitive examinations of a more or less technical nature, from Civil Service lists.

The last group is appointed by the President of the boro.

That the inspectors should be and are thoroly familiar with the contract and specifications under which the particular work to which they are assigned is carried on, need not be dwelt upon, but, in addition, each group receives printed instructions stating in detail points not specifically mentioned, but implied by the contract and

specifications, and also regulations regarding the daily reports which must be forwarded by the inspector to his immediate superior, in order that a complete record of all work performed should be available.

The key-note of these instructions is alertness, courtesy, tact and, last but not least, strict compliance with the specifications. As far as the inspector is concerned the specifications are immutable. He must enforce them not only in spirit, but to the letter. A little lee-way here and a little lee-way there, and inspection soon becomes a farce. This insistence upon strict compliance with the letter of the specifications implies that these have been drawn with the utmost care and the utmost fairness. It means that non-essentials have been eliminated and that, where definite limits have been established, these are as liberal as is compatible with safety and good work. To draw up a specification which it is intended to enforce absolutely is a serious matter, and engineers should not thoughtlessly embody unimportant details or requirements which the contractor can only live up to with great difficulty, and which hamper him in his work. Two parties entering into a contract deserve equal consideration. Competition to-day is keen and prices are low. The Boro of Manhattan does not begrudge the contractor a fair profit in return for work properly performed. It is the policy of the boro, tho insisting that the specifications be lived up to, to see that the contractor's interests are conserved equally with those of the city. Whenever the inspector can aid the contractor in expediting his work or aid him by advice or otherwise, he does so. Good fellowship must exist in order to obtain best results.

Inspectors are instructed that they are not detectives who should stealthily discover wrongdoing, but that their duty is only to see that the specifications are enforced and not violated. A contractor to-day who deliberately attempts to use material of inferior quality, or deliberately connives at inferior workmanship is an exception.

Contractors, as a rule, order their supplies from the material men, with the understanding that deliveries must comply with the specifications. As an aid in this direction and to avoid delay incident to analyzing the material after it has been brought to the line of work and rejected if unsatisfactory, it has been found practicable with some classes of materials to send inspectors to the supply men's plants to obtain samples of the stock intended for shipment to Manhattan

Boro contractors and to analyze same. If these are found satisfactory they are marked for identification and the material men notified that the particular lot meets specification requirements. When this procedure is not practical, it frequently happens that supply men, trusting apparently to lax inspection, ship material which manifestly does not meet specifications, and which has been ordered in perfect good faith by the contractor, with the result that delay and annoyance follows.

A recent case in point occurred where a broken stone aggregate, which required a certain grading, was delivered containing over 25% of material coarser than permitted. The stone was condemned. The contractor—his work tied up, his force idle—sought an interview bringing the supply man with him. The latter, one of the largest producers, stated unequivocally that a 25% excess was the best that could be obtained commercially; that if we insisted on better results it would necessitate an entire re-arrangement in the screens at his plant at an enormous cost, and only after the lapse of considerable time. Moreover, he stated that he was supplying the same stone under the identical specifications to a certain corporation using thousands of cubic yards and that it was being accepted without question. The writer trusts that the latter statement was an error. This matter, as are all questions of a similar nature, was referred to the Chief Engineer who insisted upon having the specifications complied with, and threw out the hint that the specifications permitted the use of either gravel or broken stone. This had the desired effect. A few hours later the material man stated that a stone of the desired grading would be supplied and a satisfactory shipment was received in short order. Since that time little trouble has been experienced in obtaining satisfactory stone.

The rule that inspectors must insist on the letter of the specifications being complied with has resulted in occasional complaints that attempts made by the contractor to do better work than the specifications called for have been frowned upon, and that such attempts have been frustrated and ruled out. As a general rule, where a contractor desires modification of the specifications during the progress of the work, he either is a faddist or has some ulterior motive. This is, however, not always the case. Valuable suggestions have been received from contractors which have been incorporated in the specifications at subsequent lettings. Criticism of the specifications by the contractor is always welcomed and receives proper consideration.

Inspectors frequently have difficulty in impressing upon contractors the necessity of attention to details, and yet on this is dependent the obtaining of either excellent results or indifferent results. Moreover, if the contractor will train his organization efficiently it will cost him not one cent more to do the very best work rather than poor work. The inspector can be a great aid to the contractor in training workmen efficiently by tactful suggestions—these always being made to the foreman and not to the laboring force directly.

Unfortunately the necessity and value of demanding strict attention to details is not always appreciated by contractors and their superintendents. This is the case particularly with some of the old-time road-men. A superintendent of an asphalt plant, newly appointed by a contractor, recently called on the writer and, after introducing himself and stating that he had been in the business for over thirty years, remarked that he wished to do the best work but that of course an asphalt plant was not an apothecary's shop, and that formulae of mixtures and prescribed temperature limits could not be accurately followed. This old asphalt man was mistaken. An asphalt plant of to-day is exactly like an apothecary's shop. There is no reason why the proportion of the ingredients in one batch should not, within very narrow limits, be exactly like the proportion in the next batch, and no reason why the temperature of the sand, the stone and the asphaltic cement should not be accurately controlled. There is every reason why a uniformly good asphalt pavement must be the result under a system of inspection that demands that the quality of the material used must be exactly as specified, that the ingredients must be mixed under uniform conditions, and that the mixtures must be laid with every precaution which experience has taught is necessary. For this reason defects in the asphalt pavements in the Boro of Manhattan since this system of inspection has been in force are conspicuous by their absence. It is a fact that some of the work done years ago by rule of thumb methods and under lax inspection turned out remarkably well, but this was due more to good fortune than good management, and such methods belong to the past.

It would not be possible in the scope of this paper to give a detailed account of the methods followed by each group of inspectors. A brief summary of the duties performed by the inspectors who control the output of the asphalt mixtures at the contractors' plants will indicate the methods employed in general.

The contractor having been ordered to proceed with his contract, the plant inspector visits the plant and obtains samples of all materials which it is proposed to use. The inspector himself performs the physical tests required, and forwards to the main laboratory samples of the materials requiring chemical analysis. The inspector ascertains whether the scales used in weighing out the asphaltic cement, sand, stone and filler, as also the recording thermometric instruments are in proper working order, and determines whether they are accurate. He receives from the main laboratory the formula which the contractor has elected to use in the preparation of the surface and binder mixture, which formulae have previously been submitted to the Chief Engineer, and, if satisfactory, approved by the latter. He receives instructions as to the penetration of the asphaltic cement which the contractor has been directed to use on the particular contract in question. These preliminaries having been attended to, operations are begun. The contractors' plants, naturally, are situated in outlying districts or adjoining boros necessitating frequently hauls of two or more hours with horse drawn trucks. In consequence, in order that materials should reach the line of work at a seasonable hour, plant operations are often started as early as four or five a. m., necessitating early rising on the part of the inspector. Before each truck-load of material is permitted to leave the plant the truck-driver must obtain a slip properly filled out and signed by the plant inspector, giving data as regards temperature of load, time of departure, truck number, etc. This slip must be delivered by the truck-driver to the road inspector, and no material can be accepted by the latter unless the signed slip is presented to him. The maximum temperature at which mixtures can leave the plant, varying with each particular kind of asphalt used, is prescribed, and similarly, the minimum temperature at which it can be accepted on the street. In this manner the plant inspector is brought in touch with the roadway inspector. The latter, after taking the temperature of the load, indicates this on the same slip handed him by the truck-driver. This slip eventually is forwarded to the main laboratory, where it is filed, together with all analytical data regarding the roadway, forming part of the complete history of the pavement. As the work proceeds the plant inspector each day tests the sand, stone, filler and asphaltic cement, and convinces himself that the material used is running uniformly, and by means of pat paper tests controls the proportion of bitumen in the wearing surface mixture.

If new shipments of materials are received these must be tested and approved before their use is permitted. Here, again, the contractor's interests are conserved, every effort being made to give him a report concerning the quality of the shipment at the earliest possible moment, so that unloading and use of the material if satisfactory can proceed with the least delay. Even in the case of the time-consuming complete analysis of asphalt, tho the sample reaches the main laboratory late in the day, a report is made before noon of the next day. This is accomplished thru the use of automatic time controlled ovens and automatic extraction apparatus which operates during the night. When the inspectors were first placed at the contractors' plants, they were decidedly *personae non gratae* at a number of these plants. But now their presence is welcome, as the contractor realizes that the service of a trained technical man at the plant is not a disadvantage to him.

Formerly a guarantee period of 15 years was required for asphalt surfaces. This has been reduced to 5 years and, in the writer's judgment, this period could be considerably shortened without detriment and with mutual advantage to both contractor and city.

There is no question but that the city is amply repaid for inspection expenditures at the present time.

It may be that in time the number of inspectors employed in the boro can be reduced. The writer, about two years ago, in visiting the large cities of Europe with a view of studying inspection and laboratory methods, was struck with the absence of any elaborate system of inspection. In the city of Berlin proper, for example, he was informed that the contractor himself has inspection under his own supervision and sends the materials which he uses to the Government laboratory for tests. Contracts are let under a long term guarantee, during which time the contractor must make repairs at a fixed rate, and it behooves him to do the best of work. But aside from this, the writer was informed that the contractors have so much civic pride that they only tolerate the best work, and that the contractor knows full well that he would never receive another contract unless his work was performed beyond criticism. As a matter of fact, in Berlin the contractor is inspected and not his work; that is, only firms or individuals of undoubted probity and trustworthiness are permitted to compete on work let by the city. It would be well if the American contractor would emulate his European

colleague and always have his civic duty in view. Gradually this desirable condition is becoming a fact. Not only should the contractor bear this point in view, but the inspector as well and this is impressed on the latter, namely—successful inspection demands that the inspector should always remember that he is not simply "holding a job" but that it is his own city which is being served, that it is practically his own work which he is inspecting and that he should display the same interest that we all feel in matters which directly concern us.

To summarize, inspection methods in the Boro of Manhattan require:

1. Specifications carefully drawn, embodying only essentials.
2. Enforcement of the specifications to the letter.
3. The contractors' interests to be conserved equally with that of the city.
4. Alertness, courtesy, civic pride and interest on the part of the inspector.

A SUGGESTED CHANGE OF POLICY FOR MAINTAINING THE PAVEMENT IN THE RAILWAY

By N. S. Sragué, M. Am. Soc. C. E. Chief Engineer, Bureau of Engineering, Pittsburg, Pa.

There is probably no public utility which has undergone a greater evolution in the last generation than the street railway. In the early stages of its development when the original franchises were granted for laying tracks upon and operating cars over public streets, horses were used as the motive power and the cars were small and light in weight. The benefit to localities of a street car service and the enhancement of property and land values as a result of providing convenient transportation for a nominal charge was recognized by the public and property owners when the enterprise was in its infancy. Street railway transportation has undoubtedly contributed more to the growth, business and prosperity of cities and towns than any other enterprise, excepting perhaps a good water and sewerage system.

Under these conditions, attractive inducements were offered by public officials to street railway promoters to secure the building of a road. The grants secured by the companies in many instances were in perpetuity or for a long period of years, but most of them provided, *inter alia,* that the companies should lay and maintain the pavement in the railway area and a specified width outside thereof, also sprinkle and keep the railway area clean and remove the snow. In some instances the requirements of the grantors were more exacting and in other cases considerably less but generally whatever the condition imposed, the work is performed by the companies instead of the municipalities.

The placing of the responsibility upon the companies, instead of the regular municipal authorities, for the proper laying and maintenance of the pavement in the railway area and other functions incident thereto has created a division of responsibility which is now a source of contention and litigation, expensive and annoying to both interests alike.

The increasing demand for smooth pavements and better street maintenance as a result of the general use of the motor car and truck has aggravated the situation. While the demand is reasonable

and the public entitled to receive the same standard of street maintenance in the railway area as elsewhere, yet such requirements as these were not anticipated when the grants to the companies were made and is it not now unfair to demand of the companies a standard of excellence for paving and maintenance which were never contemplated? The entire provisions of the charters relating to street cleaning, pavement maintenance, snow removal, etc., where same is delegated to the companies, is illogical and inconsistent with the legitimate function of the street railway business. Not only has there been a transformation in the kind of vehicles which use the public streets but the change in motive power, cars and other street railway equipment has been even more pronounced. The horse drawn car was superseded by the cable car and it in turn by the present trolley car. The transition from one to the other has been achieved in remarkably short stages, but it is not so much the historical development of the street railway business to which the author desires to direct attention as the conditions arising from the policy imposed by the grants, relative to pavement maintenance and track construction as produced in part by this development.

We are all more or less familiar with the poor condition of street pavements in the railway area in many cities and when the embarrassing question is asked of the public official, why this condition exists, the reply is, that it is the duty of the railway company to keep the pavement in repair; but the real essence of the matter is why the company neglects the work.

It is readily understood why this deplorable condition exists if one stops to consider that the function of a street railway is the transportation of passengers and not paving and maintaining streets. The street railway company looks upon its obligation with respect to these matters from an entirely different angle than do the city authorities. The companies are concerned chiefly with the safe and profitable operation of the roads at a minimum expense, and so long as the track is in good condition the character and maintenance of the pavement in the railway area is of secondary consideration. Moreover the requirements of the charters and ordinances respecting these features of the contract are frequently indefinite, ambiguous and more or less general and can be so construed as to suit the position taken by either side. The public official is concerned chiefly with securing for the municipality the best pavement in the railway area and a

degree of maintenance thereof comparable with that used elsewhere upon streets without respect to the requirements of railway operation.

The type or kind of pavement in the railway area and the standard of maintenance was not clearly defined in many of the franchises or ordinances and even if it had been it would be of little value to-day on account of the introduction of new types of pavements, methods of laying and cleaning. In addition to the absence of specific requirements in the grants to street railway companies concerning the matters herein discussed, many of the grants were specific to the extent of designating the kind or type of pavement which should be used and the public official has no choice in the matter but to accept this pavement whether suitable to the conditions or not.

The financial condition of a street railway company has much to do with the character of track construction, type and maintenance of pavement and compliance with other obligations. A prosperous company (and there are few of these to-day) will meet demands and make concessions more readily for improved track construction and pavement upkeep of the system and fulfill with greater fidelity its franchise obligations than one which is having difficulty in making both ends meet. In justice to the companies it should be remembered that the rate of fare has not been increased, while on the other hand there has been a very material increase in the cost of operation. The public demand for better service and equipment and the extension of the transfer privilege have also reduced the revenues of the companies. When all these things are considered it is, therefore, not surprising that the companies are reluctant to provide a modern type of pavement and to adopt a standard of maintenance in conformity with modern needs of traffic.

In most American cities street railway tracks are located in the center of the streets and where the streets are narrow traffic concentrates upon the railway area, due to the obstruction of vehicles standing alongside of the curbing; thus the central portion of the street is subjected to the greatest amount of traffic. In cities where the streets are wide there is little incentive for the drivers of vehicles to use the central part of the street and the burden placed upon the street railway company for pavement maintenance is greatly reduced.

The operation of large interurban cars and even the ordinary trolley car over city streets, combined with the motor driven truck

and other types of vehicles, the size and weight of which are increasing, would seem to require that portion of the street occupied by street railway tracks to be given careful consideration in the construction of the track and the pavement.

In all engineering structures the most careful study is given to the foundations upon which these structures are built and it is a well recognized fact that the foundation of any structure is a poor place to attempt economy. The foundation for a street pavement, however, has not in the past, in the author's opinion, received the same careful investigation as other engineering structures, but the thickness thereof has been determined in most cases by arbitrary methods, disregarding the essential elements which should be the controlling factors in fixing the thickness of the structure.

Railroad engineers contend for a somewhat flexible foundation under the tracks to reduce the wear and tear on the rolling stock and to make the riding easy, and steam railroads have quite generally adopted broken stone ballast under the ties to secure this result and also to provide drainage. The same arguments and reasons hold true for a street railway, except that the steam railways own and control the right-of-way and have exclusive use of same, whereas the area occupied by the street railway, laid on public thorofares by grant from the municipal or state authorities, is used jointly by the public and the railway company.

The municipal engineers' interest in the matter of street railway track construction is upon entirely different premises which will meet the requirements of modern pavement and which will be sufficiently rigid to prevent settlement of the track, the breaking of joints and the consequent settlement and deterioration of the pavement in the railway area. There has been a radical change in the method of track construction in the last decade which has greatly improved and reduced the necessity for repairs of the pavement in the railway area, but a substantial form of street railway track construction has not yet been adopted by many companies and is a subject of much scientific discussion among street railway officials. The author does not wish to be understood as advocating rigid track construction for all conditions and locations, as the character of soil, width and grade of street, traffic and other elements should be determining factors in the adoption of any particular type of track construction. It would seem, however, that the foundation of the pavement in

the railway area on narrow streets, subjected to heavy traffic, should at least be equal in thickness and strength to the foundation used under the pavement outside of the railway area. The importance of this detail of the design is apparent when we consider that the original horse-drawn car weighed about 4,000 pounds and the modern interurban trolley car weighs about 70,000 pounds. The former was operated upon a tram rail spiked to longitudinal wooden stringers bearing directly upon the ground, while for the latter a heavy rail section from 7 inches to 9 inches in depth is used.

It is difficult for the author to reconcile as being good engineering practice, the laying of a concrete foundation under the pavement outside the railway area and a foundation consisting of broken stone ballast within the railway area. In other words, the pavement foundation should extend from curb to curb and be of uniform construction.

A street railway track consists of two parts, the foundation and the track and pavement. The former may be considered as being permanent, while the latter is subject to wear and replacement. It would, therefore, appear that the foundation should be designed with the end in view of permanency for this part of the work. Moreover, it is essential if the work now delegated to the companies is to be assumed by the city that whatever type of track construction is used it must be so designed as to preclude the possibility of excessive maintenance and repairs, otherwise the municipality would assume a prohibitive burden. In other words, there must be a radical change in the design of street railway track construction as now used by many companies before it would be possible to even consider the taking over by a municipality of certain work now performed by the companies. Hence, the first step looking toward a change in policy is an agreement between the city and the company upon a satisfactory type of track construction.

A change in policy must necessarily be gradual as it is manifestly impracticable to undertake the reconstruction of an entire track system so as to make the change effective at once on all streets where tracks are laid. The author's idea is to make the change where a new grant is given and when reconstruction of present lines is necessary. The city should provide a continuous concrete foundation for the street pavement and track extending from curb to curb. If objection was raised to laying the ties directly upon the concrete,

a depression in the foundation could be made so as to permit the placing of ballast between the upper surface of the concrete foundation and the under side of the ties. The company should provide and lay track, including ballast, complete ready for paving and the paving should be done by the city. The maintenance of the pavement in the track area should devolve upon the city and when disturbed for repairs to joints or track should be replaced by the city at the expense of the company.

Sweeping and cleaning the railway area is a condition imposed upon the companies at a time when horses were used for motive power but is now obsolete. The operation of trolley cars over city streets makes little if any dirt and the funds expended for sweeping the railway area could be invested in better track construction or equipment which would be to the mutual advantage of both parties. The author does not wish to be understood as advocating a policy which would relieve the railway companies of existing franchise obligations but rather a change of policy, so that a municipality would receive an equivalent return for work performed but in different form. The rearrangement of the present policy is primarily an engineering problem which must be solved jointly between the engineers for the companies and the city. When agreed upon the scheme could be made effective by legislative action or such other course of procedure as required by law, or the terms of the grants to the companies. The purpose to be accomplished is to make the city authorities responsible for paving, maintaining, cleaning, sprinkling and the removal of snow from the railway area as well as outside of same.

There are several ways in which the companies could reimburse the cities for the cost of the work undertaken.

(a) An annual lump sum payment covering the actual cost of all functions performed by the city.

(b) An annual fixed tax based upon the average yearly cost of the work with provision for increase at stated intervals on account of growth and extensions of lines.

(c) Annual payment based upon net receipts.

(d) Annual payment based upon total area occupied by tracks.

Other and perhaps more equitable and logical bases of compensation are possible.

The adoption of the suggested change in policy of laying and maintaining the pavement in the railway area would, in the writer's opinion, make it possible for the city to establish a greatly improved standard of pavement maintenance including the incidental but necessary functions of street cleaning, sprinkling and snow removal. Under present conditions of divided responsibility such a standard is not feasible. Some of the principal benefits which may be expected to result from the proposed change of policy as herein suggested are as follows:

(a) Improved pavements and maintenance.

(b) Uniform type of pavement for full width of street.

(c) Simplification of control.

(d) Economy of construction and efficiency of maintenance.

The utter impossibility of reconciling the divergent opinions of municipal and company officials, the increased demand for better pavements and the loss in economy in the present arrangement, will make it imperative in the writer's opinion to adopt a change in policy in the regulation of the street railway area somewhat along the lines herein outlined.

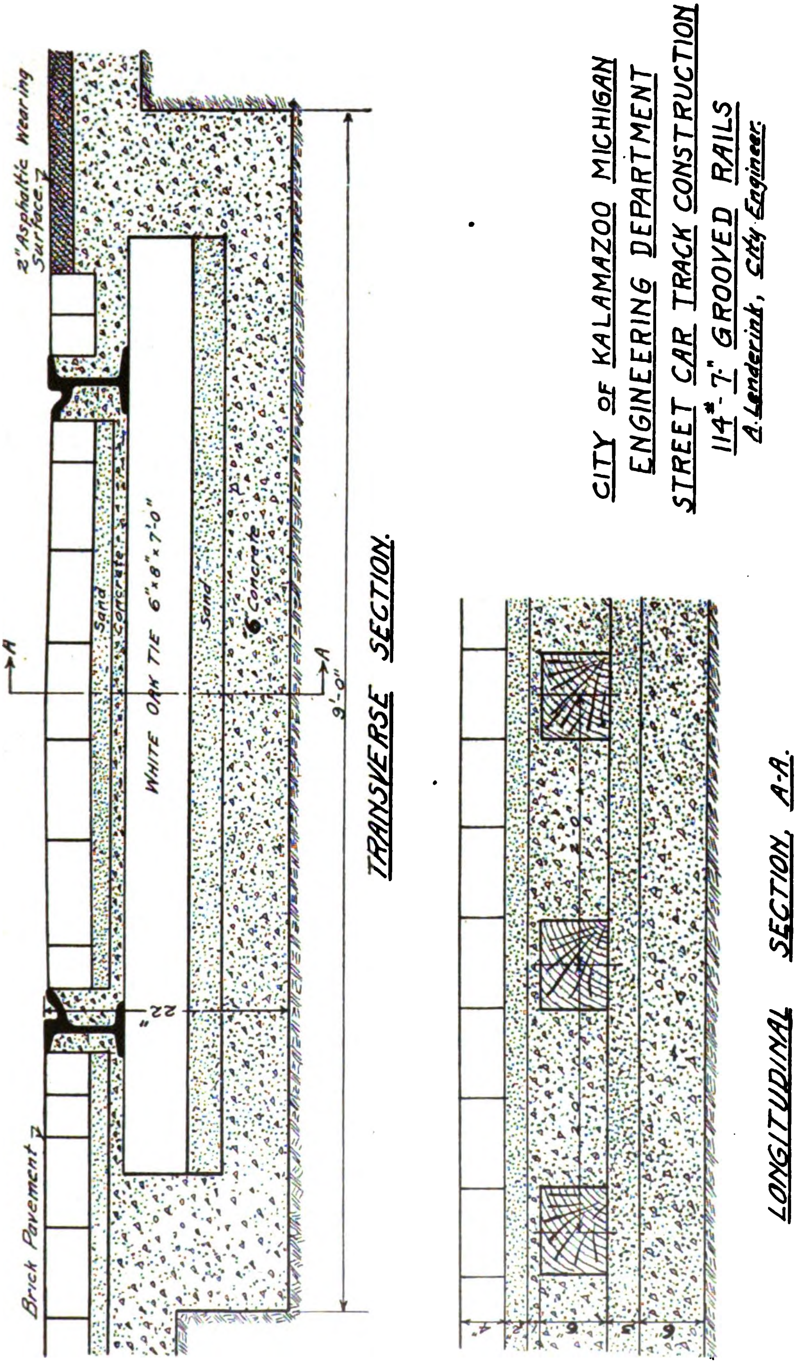
Inasmuch as any change in policy with respect to this matter must be gradual, the author believes that the subject is of sufficient importance to warrant its adoption at least upon any new grants for the construction and operation of street railways.

DISCUSSION.

Mr. Tribus: Just a brief word on a matter of interest. I had a number of years' conflict with a street railway company. Under the New York state railroad law the street railroad companies are obliged to lay and maintain pavements between their tracks, between the rails, and two feet outside thereof. Under the New York City ordinances they are required to remove snow. Designation of type of rail and kind of pavement is vested in the local authorities. This particular company, operating quite a mileage, on receiving notices to make repairs, objected and failed to do so. The city then proceeded to do the work, and sent in bills. When the bills aggregated several hundred thousand dollars, the railroad began to sit up and take notice; then defended suits and lost them. Then the railroad company was very willing to make an arrangement, which for a

number of years worked out very satisfactorily. Notices would be sent that a particular street was to be repaved or repaired. The railroad company said, "Very well, we will either join in the same contract with you, or we will pay the bill for our share if you will have the work done." That was done, and for a number of years the bills were paid very regularly, the railroad officials expressing complete satisfaction with the arrangement. They felt that they were getting good value for their investment, and saved litigation. The snow removal requirement under an ordinance was a nuisance for quite a time. The railroad would remove snow or not, as it saw fit. We then forced an agreement on a workable basis. We estimated the yardage for which the railroad was responsible; then picked out certain streets where the railroad should do all the work of removal from curb to curb, while the city would do similarly elsewhere. That worked out very well indeed. As to street sprinkling, a similar arrangement was entered into. The railroad with its pressure tanks would sprinkle the full width of the pavement for a designated mileage, and the city would care for other streets. It was a commonsense practical arrangement between the corporation and the city. Then the kind of track, kind of rails, and character of foundation, came under consideration. The pavement was constantly being broken into by the railroad company. We finally said, "This must stop", and under steady pressure the railroad company began to make solid roadbeds and the officials later acknowledged that it improved the operation of their cars. A heavy concrete girder was built under each rail, steel I-beam cross ties being placed at about ten feet centers simply to hold the rail in gage until the concrete pavement foundation was finally set, filling between and over the ties and continuously across the full street. The rails were not welded together but held to a very close joint, making a very rigid roadbed. These methods worked out very satisfactorily for a number of years. Then the company, anticipating a change of administration and hoping for easier times, said, "Well, tho these arrangements have worked satisfactorily, we would rather maintain the space between our tracks under private contract." The city said, "All right, you can do so under the law." But it does not work as well as under the old agreements.

MR. LENDERINK: In Kalamazoo we did use a heavy concrete stringer under the rails, with wooden cross ties spaced about 8 feet apart. We found where the joints began to go down that this type


CITY OF KALAMAZOO MICHIGAN
ENGINEERING DEPARTMENT
STREET CAR TRACK CONSTRUCTION
114#-7" GROOVED RAILS
A. Lenderink, City Engineer.
2" Asphaltic Wearing Surface
Brick Pavement
Sand
Concrete
WHITE OAK TIE 6"x8"x7'-0"
Sand
6 Concrete
22"
9'-0"
A
A
TRANSVERSE SECTION.
LONGITUDINAL SECTION, A-A.

of construction was hard to repair; so now we have adopted a system whereby the concrete foundation is continuous from curb to curb, with a depression under the tracks for the ties, and upon this concrete foundation we use from two to three inches of ballast of gravel. We find that this type of construction is giving us the best results, and that the maintenance is very much easier this way.

MR. PARMALEE: Our town's business with the street car company does not include sprinkling or snow removal but it has included a point which perhaps it would be well to bring to the attention of the Society, which is as follows: Their franchise with the city provided that, in all paved streets or streets to be paved, they should pave an area bounded by lines drawn 18″ from the ends of the cross ties. Using a 6′6″ tie this would make their area 9′6″ wide. However, they introduced longitudinal means to carry the rails and the rails were tied with tie rods spaced every ten feet and maintained. Having done away with the cross ties, they did not have to pave an area 9′6″ wide but 6′ wide. The dispute was finally compromised by counting the 18″ from the end of the tie rods making the width of the area paved by them about 8′, or 18″ under that which was originally intended.

MR. WARREN: I was very much interested in Mr. Tribus' remarks about his experience in one of the boro of New York, and especially as to the success they had had in getting the railroad companies to practically provide the rigid construction, a construction of concrete under ground, of open ties, with a good heavy rail. We all know that railroad companies as a rule object to that, and give as their reason—and I confess that I have never been quite clear in my own mind about that—that it will wear out their rolling stock. I would like to ask Mr. Tribus if, after the railroad company has discovered that they had a condition and not a theory, they subsequently raised any serious objection to the rigidity of the construction as such.

MR. TRIBUS: I can answer that question by saying that within twelve months after the concrete girders were in place and the most solid type of foundation that we could devise in use, the operating officials of the railroad company told me that they would not go back to the old system for anything. They were delighted with the

solid roadbed. They had fewer flat wheels and better general operation; the track laid according to that method being about as solid as it could be made.

SECRETARY BROWN: The only questions in the question box are on this question of permanent pavement construction between the car tracks, and perhaps it might be well to read them now, as the answers to the questions may help in the discussion. The first one is, "Are cedar ties too soft to be used when spaced 2 foot centers and the concrete 6 inches below the ties up to the base of the rail?

MR. PARMELEE: In my experience, I would say that they would not be.

MR. LENDERINK: We use the oak ties in that space two feet apart, and find oak ties are much better than cedar.

SECRETARY BROWN: The next one is, "When using 90 lb. T-rail, A.S.C.E. section (5⅜″ high), is it necessary to use either rail braces or tie rods?"

MR. LENDERINK: That depends a great deal on the traffic.

MR. CHRIST: Mr. Chairman, in our city we use the tie rods. We separate the pavement on the inside and outside of each rail, so that the track can go down without disturbing the pavement. That is one of the reasons I stipulated putting the rail above any pavement to a certain extent. In regard to the concrete girder, I was in Minneapolis twelve or fifteen years ago, and they had used the concrete girder, imbedding the rail in the concrete, and after using it four or five years they made an examination of the joints and found that the concrete below the rail had pulverized and worn the rail off on the bottom. I do not believe there is any suitable foundation for a street railroad track that is permanent.

SECRETARY BROWN: (Reads) "When using brick pavement between the rails and 1 foot outside, is it good practice to lay the brick in rows parallel to the rails?"

MR. CHRIST: I would say no, if the pavement is laid independent of the track, as stated above. If laid parallel, there is no bond

between driveway portion and the track portion, and unless the track has a permanent foundation a rut will form which will soon destroy the pavement.

SECRETARY BROWN: (Reads) "When it is necessary to run cars before the grout is set in the joints in the foot of pavement outside the rails, how can the damage be prevented to the filler?"

MR. CHRIST: I will say, I had a case of that kind in Grand Rapids and the cars never stopped a minute. The construction I recommend with a brick pavement,—of filling in the web of the rail with concrete before the bricks are laid, separating the rail from the pavement—will allow this to be done.

MR. TRIBUS: I would say, that altogether depends on whether or not there was a rigid base supporting the car track. If there is, it will not hurt the pavement; otherwise, it will.

MR. MACALLUM: I adopted the same construction as Mr. Tribus has mentioned, of using the steel ties and rods. But just on this point, in one case where an interurban railway ran its cars over the base before the time was up—that is, it ran either three or four days after the grout was laid—and within a year's time there was certain effect at every joint. It was a wood block pavement.

A MEMBER: You could remedy that condition by using asphaltum filler instead of cement.

SECRETARY BROWN: (Reads) "Is ¾" mortar cushion (1 to 3 mix.) sufficient under the brick?"

MR. BLAIR: In answer to that, I think the brick committee has fully covered that situation.

MR. CHRIST: I think it is enough if the foundation will allow of it.

SECRETARY BROWN: (Reads) "How much below the top of the rail should the outside brick be laid?"

MR. CHRIST: I would say, see the specifications.

REPORT OF COMMITTEE ON TRAFFIC ON STREETS.

L. L. Tribus, Chairman, Consulting Engineer, New York City.

Traffic on streets is of importance as a study, from two special viewpoints:—

1st. Movement.

2nd. Cleaning.

3rd. Wear.

The first becomes largely a police problem after the engineer has determined widths, grades and alinement, but traffic estimates have controlling bearing on these factors.

The second is a special topic which another committee of this Society is handling, so will remain undiscussed in this report.

The third is financial, but dependent on successful engineering and intelligent study of traffic conditions, existing and prospective.

The three problems so fit together, however, that segregated study is almost impossible.

Your committee sent inquiries on May 20th to 60 well known engineers who have to do with municipal conditions in their respective cities; it hoped to gather many items of value and interest upon some at least of the following ten (10) items or allied ones.

1. Reservation of certain streets for special traffic.
2. Relationship of tires to loads, and unit loads as affecting pavements and sub-surface structures.
3. Speed effect on pavements of vehicles of different weights and kinds.
4. Effect of non-skid and braking devices on different pavement surfaces.
5. Cross section of pavements in relation to traffic.
6. Traffic census and its bearing on selection of pavements.
7. Regulation of traffic in narrow lines of travel versus wide streets and open plazas with unrestricted use;—safety and larger aisles versus no segregation of space.
8. Center parking of vehicles versus use of space next to curbing.

9. Car tracks in center of roadways versus location near curbs.
10. Auto busses for local traffic versus street railways in large cities.

We confess the disappointment that generally meets committees, as most of those addressed failed even in the courtesy of a reply, consequently we hold in higher esteem those who from their experience have sent us comments and papers.

Mr. W. W. Crosby, Consulting Engineer, Baltimore, has given us a paper published separately, entitled:

"The Traffic Census and its Bearing on the Selection of Pavements."

Mr. Clarence D. Pollock, Consulting Engineer, New York, gives us various items as follows, and will probably further extend the information at the Convention:

> "Municipal engineers are often confronted with the question of separating pleasure traffic and heavy slow moving vehicles. But such an attempt brings up the argument that the street belongs to the public and that the public has a right to use it just as it sees fit. However, in the case of park drives and boulevards, the separation is frequently carried out, in a manner which is satisfactory to all concerned.
>
> The writer has found it desirable to pave certain streets at convenient intervals, with material suitable for heavy traffic, and suitable for use under all weather conditions, even in sections which are mainly residential. Without much attempt to separate traffic, on the part of the police, it was found that heavy loads soon sought out these heavy traffic pavements, without any definite traffic regulations to compel the same.
>
> The relationship of tires to loads, and consequently the loads to be taken care of in constructing pavements, is pretty well settled in the case of automobile trucks with solid rubber tires. The Auto-Truck Owners in New York City have found the maximum economical load on solid rubber tires to be 700 pounds per inch width of tire in contact with the pavement. If loads on metal tires should be limited to this figure, paving engineers would have pretty definite data for use in determining proper foundations and wearing surface for the heavy traffic streets.

The cross-section of the street should be as flat as possible, and yet get the water off quickly. The flatter the surface, the better is the distribution of the traffic. For streets of moderate width a good result is obtained by dividing the width of a roadway in feet, by six (6), and using the result as the crown in inches, taking the nearest whole number.

A traffic census does not mean much in selecting pavements, unless the character of the traffic is obtained, such as the number in various weights, whether rubber tired or metal tired, etc. Even then it must not be applied blindly as though it was a multiplication table.

As to the parking of vehicles, this should be prohibited upon important business streets. Vehicles should be compelled to go to the side streets for parking. If these are of sufficient width to permit of center parking, this is desirable, but if not it will be necessary to park along the curb. This, however, is detrimental to the business houses along the street.

The car tracks should be in the center of the roadways, wherever possible. There is much more danger of accidents if the tracks are near the curb."

Mr. E. P. Goodrich, Consulting Engineer of Borough of Manhattan, City of New York makes comments upon the formulated questions as follows:

"(a) Very much in favor of reserving certain streets for special traffic.

This applies to pleasure traffic and also to heavy commercial traffic. The scheme of reserving certain streets for pleasure traffic is already in force on parkways, boulevards, etc. The Borough of Manhattan is arranging certain streets with extra heavy paving foundation, and special wearing surface, with the idea that traffic routes may be determined along which extra heavy vehicles should be compelled to move.

(b) Special studies are being made by three or four associations and committees of citizens, automobile owners, etc., with reference to the maximum size and weight of all vehicles which may be permitted upon the streets either with or without special license. Several special ordinances have been introduced, but thus far without result. The Chairman of your Committee has a copy of one proposed ordinance.

(c) As far as the effect of speed on the pavement is concerned, those of the Borough of Manhattan show no evidence except those on Riverside Drive and its extension (Boulevard Lafayette) with a small additional stretch of Ft. Washington Ave. The surface of both water-bound and asphalt macadam has been thrown to the side of the roads especially at curves, apparently by the high speed with which automobiles traverse these drives. An interesting photograph is in the possession of Mr. H. W. Durham, ex-Chief Engineer of the Bureau of Highways, Borough of Manhattan, of the speedway leading out to Berlin, in which distinct grooves are evident in a granite block pavement over which only rubber tired vehicles are permitted to operate.

(d) Braking devices on vehicles have produced appreciable displacements of asphalt block pavements on several hills, where the originally straight line of blocks across the roadway has been pushed downhill as much as 3 feet in some cases.

(e) "Cross section of pavements in relation to traffic" is an indefinite expression. Pavement should be laid with the minimum crown; and the section between curbs should be some odd number of traffic units in width, unless a double line of street cars occupies the street, when the width can be an even number of traffic units. In this connection, however, a street car traffic unit is of greater width than any other variety.

(f) Traffic censuses should be taken periodically, and so segregated as to show the percentage of horse-drawn and of iron tires. The kind of traffic thus disclosed should be one of several elements used in determining the type of pavement to be used in any case for original or reconstruction work.

(g) With any amount of traffic, it needs careful regulation in relatively narrow lines of travel with right angle crossing at every point of intersection. Unrestricted use of open space is permissible only with relatively small amounts of traffic. Safety isles are advantageous at some points where roadways are 60 feet wide and upwards, and at points of special congestion under certain circumstances. It is believed, however, that they should almost never be permanent in nature, rather being marked out by painting the surface of the pavement and by the erection of movable stanchions with heavy bases.

(h) Since vehicles must stop against the curb to allow discharge and picking up of passengers and freight, their pause for this purpose would practically monopolize one traffic width adjacent to the curb wherever local stopping, as above described, takes place to any great extent. Under such circumstances it is wiser to park vehicles adjacent to the curb than to use the center of a street along the sides of which stopping of vehicles also takes place. In the latter instance, three traffic widths are out of active use; while, where there is no center parking, two units in width are all that are lost. It is impracticable to place car tracks near curbs wherever vehicles are permitted to stop at the curb to load and unload passengers and merchandise. The greater convenience to the public in boarding cars near the curb is usually more than offset by the delays in street car operation.

(i) If properly regulated, auto busses can be made of marked value to the community for local traffic as feeders to street railroad lines, and as auxiliaries through the congested districts. They can not compete over long distances or through sparsely settled districts."

Mr. D. R. Lyman, Chief Engineer of Louisville, contributes brief replies to the questions which it is hoped will be followed by others at the Convention with classified statistics and deductions.

"(a) No reservation of certain streets for special traffic in Louisville.

(b) In 1895 an ordinance was passed regulating the loads on vehicles, specifying the minimum width of tires for unit loads. Unfortunately this ordinance has never been enforced, but if it were, it would be found very much out of date, as it, of course, did not contemplate motor traffic.

(c) There is no regulation of the speed of vehicles of different weights and kinds, there being only a general speed limit under the police regulations. We have not noticed any appreciable effect of speed on the pavements but this is probably due to the fact that motor traffic has not reached the volume it has in other cities.

(d) No deleterious effect has been noted from non-skid and braking devices.

(e) Cross-section of pavements is related to character of pavements and not to character of traffic, except when considered in its entirety is sub-grade, foundation and wearing surface as well as crown.

(f) Traffic census has been used only to a small extent although its virtues are undoubted.

(g) At important intersections traffic is required to traverse narrow lines under police supervision. On wide streets safety zones are provided.

(h) All vehicles are parked next to the curbing. This is necessitated by the fact that all wide streets carry street railway lines in the center. I very much prefer center parking where practicable.

(i) Street railway tracks are all located in center of roadway, although there would be advantages in locating them next to the curbing where streets are wide enough to accommodate traffic and permit center parking.

(j) Auto busses are used to a very small extent, nearly all local traffic being carried by street railways."

Mr. Theodore S. Oxholm, Acting Chief Engineer, Boro of Richmond, city of New York, submits a Winter Traffic Census covering the period from Jan. 26 to March 15, 1914, taken at the same stations (and presumably under the same conditions) as were noted in the Traffic Committee's report as found on page 191 of the Proceedings of the 1914 Convention.

The figures naturally indicate much less travel, but close observation might possibly indicate a harder use of the pavements, due to chains on auto tires and chains and sharp calks on horses' hoofs.

Observation Station	No. of free Moving Vehicles	Electric Cars	Total No.	Weight of Vehicles (Excl. cars) Tons
A-1	109	105	224	342
A-2	22	...	22	46
B	441	287	728	1131
C	495	283	778	1233
D	364	59	423	823
E	362	77	439	688

F	634	215	849	1781
G	860	420	1280	2405
H-1	974	119	1093	2261
H-2	539	...	539	1321
I-1	627	115	742	1306
I-2	166	...	166	363
J-1	390	197	587	845
J-2	173	197	370	381
J-3	204	...	204	496
K	232	...	232	470
L	106	...	106	236

Mr. E. R. Conant, Chief Engineer of Savannah, regrets that no real study of this subject has been made in Savannah, but appreciates its importance and confesses to a desire to give time and attention later, if possible:—this is hopeful.

Col. J. W. Howard of your Committee offers the following pertinent answers to the questions promulgated:

(a) Some streets, avenues and public places, used by vehicles must necessarily be reserved for special kinds of traffic, as has been done for the benefit of the traffic and public in the large cities of Europe for many years and is lately being done in cities of the U. S. A special study of quantity of local traffic conditions and street net work is needed in each case.

(b) The weights of loads per wheel and per inch of width of tire are important factors to be considered in connection with the strength of pavement foundations, the kind and thickness of wearing surface layers, and especially their subsequent constant maintenance in good, viable condition, in order to obtain efficient and continuously economic pavements.

(c) The effect of speed of vehicles on pavements and roadway surfaces is a matter of importance, especially due to the backward thrust of the driving wheels of motor vehicles on several kinds of pavement and road surface materials.

(d) Non-skidding devices, such as chains and other projections, should be of the minimum sizes which will prevent skidding; because at best chains injure pavement surfaces and larger ones do the most injury. The size, etc., of chains and

other non-skidding devices are regulated by law in several European countries and I believe are beginning to be so in the United States. I think the Park Department which has Boulevards running thru the interior of Chicago adopted a regulation of sizes and shapes of non-skidding devices. As to brake devices, they should not be such at to lock a wheel, because in that case the thrust or plowing effect of the locked wheel is detrimental to most pavements.

(e) The cross section of pavements should be such as to have the roadway as flat as is consistent with proper drainage under local conditions for each street.

(f) The traffic census is a factor of the utmost importance to be used in the selection of kind, thickness and strength of pavement and road foundations; also for the selection of the kind of pavement wearing surface in respect to its initial cost, durability, subsequent maintenance in continuous good order; whether that maintenance is by means of constant, small repairs, or resurfacing after long intervals of time or both combined, to secure constant viability together with efficient, economic results. A standard method of recording, classifying etc., traffic is given with forms etc., in the report of this Committee published in the Proceedings of 1912, pages 137 to 149, which reduces the traffic to vehicles and tons per yard of width, etc.

(g) Traffic in some large cities and where numerous and moving at different speeds (fast for passenger, slow for merchandise) in some cities, must be compelled to travel on separate zones and in narrow lines on wide streets in both directions, and on some narrow streets all traffic must travel in one direction only. Safety isles for pedestrians have been necessary in large European cities for 40 years and are being introduced where local conditions require in American cities. This also facilitates the mobility of vehicle traffic because that traffic is thus much less impeded by groups of people attempting to cross or standing on the vehicle portion of streets.

(h) Whether vehicles shall be parked in the center, on the sides and elsewhere on public streets, plazas, etc., is a local question. Reservations for parking are increasingly necessary with the increase of automobiles.

(i) Street car tracks, with few exceptions, are best in the center of roadways. Local boulevards and special conditions sometimes permit the rails to be placed elsewhere, or thru portions of roadways finished as parks with bushes, grass, etc.

(j) Auto busses, including small auto vehicles, are increasing and will probably eventually all be called "jitneys", which constitute a problem to be hereafter solved, because the jitneys have come to stay. They will, to a certain extent, make it unnecessary to extend street railways into subordinate sections of cities, and eventually will be accessory to street railways and enable an ever increasing number of streets to be paved from curb to curb without having iron rails, which are detrimental to pavement construction and maintenance.

The Chairman may perhaps be excused from a special contribution, but will submit a few notes on points incidental to or allied with this topic. He has been much interested in certain grade crossing elimination proceedings, which brought out the great value of a careful traffic census, that enabled direct estimates to be made, translatable into capital cost and fixed charges.

In round numbers the census figures for this particular crossing showed that over 100,000 electric street cars passed the point in year ending June 30, 1915 and carried over 2,700,000 passengers. The delay from steam railroad gates being down averaged three minutes for each car, hence for the passengers alone the loss of time on basis of 8 hour work days, about 300 per year, equaled some 60 years for one person. At the low average annual wage of $500, this makes the comfortable direct total of $30,000. Deducting, say $5,000, as representing non-productive Sunday and holiday trips, leaves $25,000 per year of direct loss which could be saved by the elimination. Adding other vehicles and pedestrians as noted in the census, wages of gate tenders, wear, and interest on operating machinery, some delay to the steam traffic, etc., makes a large annual total to be saved—far beyond that sufficient to carry capital and maintenance charges of a costly structure and attendant charges and damages.

Prior to efficient police traffic management, in every large city, blocking of vehicular traffic attended the busy hours in some of the more important streets; the introduction of horse-drawn street cars as against stages, tended to force movement into parallel lines, re-

lieving very greatly the old time blockades. Later cable and electric traction, with smoother tracks and greater power, still further aided to lessen congestion and increase transportation facilities.

Now improvements in self-contained power vehicles brings a problem of vital importance to the front, viz., the use of motor busses with their greater flexibility of travel and hence competition with track bound cars.

It probably will be many days before the cost of their power can be brought down to that furnished by central stations, but other factors enter into the subject which give to the auto-bus increasing popularity, even for comparatively long distance trips.

The subject for our consideration is, however, the effect on traffic as a whole and construction and maintenance of streets in particular.

All will admit that pavements where travel is confined to parallel lines, wear out much faster than when greater irregularity of movement is possible, consequently to eliminate the street car helps the paving problem; i. e., at first glance. One must consider the effect, however, of carrying an equivalent number of passengers in other vehicles having lower speed, somewhat less capacity and a more or less bumpy instead of smooth motion. May it not be a standoff as to wear and tear, with less traffic capacity, for the same width of street.

In London and Paris large use is made of auto-busses—in New York they are becoming annually more popular.

The Jitney, whose name is on every tongue, does not serve the same purpose, having no fixed routes, and as yet is scarcely an important factor in a large city street life.

For long distance city travel—probably tracks—elevated or subway and to lesser degree, as years go on, surface, will be essential from viewpoints of moderate cost and speed;—for short runs, the more flexible the service, the greater will be the comfort of travelers and where time is of such value to so many, a larger direct expense will be well warranted.

These matters are all translatable into pavement surfaces and foundations, consequently initial and maintenance costs, hence the value of intelligently gathered traffic figures.

The subject does not end when the street is paved and the maintenance force organized. A community's police powers must be evoked else wasteful conditions will develop.

Usually in a city, taxation is general for most of its functions, but where possible without injustice, placing the burden of expense upon the sources of cost is not an improper principle.

For some years the Boro Engineers of New York (of which the chairman was a member), organized as a Board of Consulting Engineers, strove to arrange for such a placing of some of the burden of street wear upon those directly responsible.

They formulated carefully prepared ordinances; based on almost innumerable observations, measurements and comparisons; to cover vehicular use of streets;—unit loads—weight per wheel, weight per inch width of tire: speed for maximum load;—width of vehicle and load over all; licensing and fees (regular and special).

The public, represented by the aldermen, has not yet become sufficiently educated to the point of recognizing the justness of the plan, but the hoped for day will come sometime.

The letter of transmittal by the President of the Borough of Manhattan, gives some points of interest and the ordinance terms may prove helpful and suggestive elsewhere, even if New York itself will not profit as yet by them.

"City of New York, Office of The President of The Boro of Manhattan, City Hall, February 24, 1913.

Hon. JOHN PURROY MITCHELL, President, Board of Aldermen, New York City:

Dear Sir—For some months past the Consulting Engineers of the five boroughs have had under consideration the desirability of securing better control over the use of the streets of the City by vehicles transporting excessive loads. In recent years these vehicles have increased in size and carrying capacity until it is now a common sight to see trucks and wagons carrying from three to five tons of coal, broken rock or building material through the City's streets. There are also a number of vehicles, such as those operated by the Fifth Avenue Stage Coach Company, which are so constructed as to exert an excessive wear and tear upon the pavements. This results, in its last analysis, in imposing upon the taxpayers in general an excessive charge for pavement maintenance, for the benefit of a comparatively few concerns operating such vehicles.

After a very careful examination and inspection of the kinds of vehicles now in use in the city, and the effect of their operation on the various pavements, it is the opinion of the Engineering Board that there are three very glaring abuses which can be, and should be, immediately checked:

(a) Certain vehicles are operated with too narrow tires for the load transported. This results in cutting a gash in an asphalt pavement, which utterly ruins it. The tire should be proportioned to the load the vehicle is intended to carry.

(b) Other vehicles are too heavily loaded for any pavement to support. Our pavements are built upon a 6-inch concrete foundation. This will support an exceedingly heavy traffic. But if a foundation is to be laid to support some of the loads now commonly seen on the streets, the cost of street construction will be greatly increased, thereby imposing a heavy tax upon the city at large for the benefit of a few.

(c) A third class of vehicles are those having an excessive width. The main thoroughfares of the city have recently been widened at considerable expense in order to accommodate two lines of traffic, of regulation width, going in opposite directions. A modern automobile truck or van, measuring eight or nine feet in width, will completely block one extra line of traffic, thereby reducing the capacity of the street by 50 per cent in either direction.

These are evils which can and should be checked at once; and I have accordingly had drawn an ordinance regulating:

(a) the proportion which the load of any vehicle shall bear to its tires;

(b) the load which may be carried upon any vehicle, estimated upon the per wheel basis; and

(c) the excessive widths of all vehicles.

Recognizing, however, that the construction of large buildings and the progress of many important public works may, at times, necessitate the transportation of heavy timbers or steel beams through the streets, the proposed ordinance further provides for the issuance of single permits for individual trips of this nature, upon payment of specified fees.

The necessity for some regulation of this kind is apparent and urgent. Such excessive wear and tear upon, and concrete damage to the pavements cannot be embraced within the meaning of ordinary street use. In many cases it is unnecessary. It is imposing a constantly increasing burden for pavement maintenance upon the city at large for the benefit of a few; and it is in reality in large part an economic waste.

I recommend, therefore, that the ordinance submitted herewith be placed before your Honorable Body for its early and careful consideration.

Respectfully,
GEORGE McANENY,
President, Borough of Manhattan.

AN ORDINANCE Regulating the Widths of Tires, Wheel Loads and Widths of Vehicles.

Be it Ordained by the Board of Aldermen of The City of New York as follows:

Section 1. No vehicle shall be allowed to use or pass over the pavements of any street of the City of New York after the passage of this ordinance without a license from the Bureau of Licenses of said City; and the Bureau of Licenses of the City of New York is hereby authorized and directed to regulate the widths of tires, loads per wheel, and widths of vehicles using or passing over the pavements of the City of New York, and to issue licenses or permits, to charge and collect fees, in addition to any other fees elsewhere authorized, to employ such clerks and inspectors as may be provided for by the Board of Aldermen and the Board of Estimate and Apportionment, and to provide weighing stations as hereinafter set forth.

Section 2. Annual licenses shall be granted upon payment of the fees specified in the following schedule, to wit:

(a) Vehicles carrying or intending to carry a total gross load of 6,000 pounds, or less, upon any wheel, shall be charged the following annual license fees:

Loads in Pounds Per Inch Width of Tire.	License Fee For Each Vehicle.
750 or less	$1.00
More than 750 but not to exceed 800	3.00
More than 800 but not to exceed 850	6.00
More than 850 but not to exceed 900	12.00
More than 900 but not to exceed 950	25.00
More than 950 but not to exceed 1,000 (maximum)	50.00

(b) In addition to the fees provided in subdivision "a," further fees shall be charged for loads greater than 6,000 pounds, but not exceeding 10,000 pounds upon any wheel as follows:

Weights in Pounds Per Wheel.	License Fee For Each Vehicle.
More than 6,000 but not to exceed 6,500	$75.00
More than 6,500 but not to exceed 7,000	110.00

More than 7,000 but not to exceed 7,500	150.00
More than 7,500 but not to exceed 8,000	200.00
More than 8,000 but not to exceed 8,500	300.00
More than 8,500 but not to exceed 9,000	500.00
More than 9,000 but not to exceed 9,500	750.00
More than 9,500 but not to exceed 10,000...........	1,000.00

For loads greater than 10,000 pounds per wheel, license fees shall be charged for each vehicle at the additional rate of $500 for each 1,000 pounds increase in weight, or portion thereof, per wheel; provided, however, that no load greater than 1,000 pounds per inch width of wheel shall in any case be permitted, except as specified in sub-division "d."

(c) Vehicles 6 feet 6 inches or more in width over all shall be charged, in addition to the fees specified in subdivisions "a" and "b," the following annual fees:

Width of Vehicles.	License Fee For Each Inch In Width In Excess of 6 Ft. 6 In.
More than 6 ft. 6 in. but not to exceed 7 ft. 0 in.	$5.00
More than 7 ft. 0 in. but not to exceed 7 ft. 6 in.	10.00
More than 7 ft. 6 in. but not to exceed 8 ft. 0 in.	15.00
More than 8 ft. 0 in. but not to exceed 8 ft. 6 in.	20.00
More than 8 ft. 6 in. but not to exceed 9 ft. 6 in.	25.00

In determining this fee, any width which is greater than 6 feet 6 inches by a fraction of an inch, or by distance which contains a fraction of an inch, shall be reckoned as if it were the next greater even inch.

(d) No loads, rigging, harness or other appurtenance shall in any case be allowed to extend beyond the outside limits of any vehicle except as specified in sub-division "c."

(e) In lieu of the fees hereinabove provided for in sub-divisions "a" and "b" for loads of 6,000 pounds or more on any wheel, special permits may be issued for single trips and fees charged therefor, at the rate of 10 per cent of the fees therein provided, except that no such single fee shall be less than $25; and in lieu of the fees provided in subdivision "c" for excess width of vehicles, special permits for single trips may be granted upon payment of a single fee of not less than $10.

Section 3. Duplicate plates stating the weight of empty vehicle, the maximum load capacity per inch width of tire and per most heavily loaded wheel and width over all of vehicle, shall be furnished by the City upon payment of the license fees herein established, and shall be permanently attached in a conspicuous place on each side of the vehicle as directed by the Chief of the Bureau of Licenses.

Section 4. Suitable weighing stations shall be established in various parts of the City in such numbers and at such places as may be determined by the Board of Estimate and Apportionment upon the recommendation of the Chief of the Bureau of Licenses. All vehicles shall be weighed at one of such weighing stations whenever required by a duly authorized representative of the Bureau of Licenses.

Section 5. Any violation of the provisions or regulations of this ordinance shall render the owner of such vehicle liable to a revocation of its license, if any be held, and such owner shall be deemed guilty of a misdemeanor, and may upon conviction thereof be fined not less than $100 nor more than $500, and in default of payment of such fine may be committed to prison for a term not to exceed ten (10) days.

Section 6. All ordinances, resolutions, permits or licenses heretofore adopted, issued or granted by the City of New York, or by any board, body, council or officer thereof, or by any department, division or bureau thereof, permitting, licensing or regulating the widths of tires, loads per wheel, and widths of vehicles using the pavements of the City of New York, are hereby in all respects repealed, canceled and revoked.

Section 7. This ordinance shall take effect ninety days after the date of its approval by the Mayor.

Which was referred to the Committee on Laws and Legislation."

The effect of high speed heavy traffic on certain kinds of pavement, particularly asphalt block, has been frequently noted on grades in the radical movement of the pavement in direction of travel. To meet this the Chairman's firm has recently used occasional cross rows of non-creep blocks. These are ordinary blocks into which have been pressed elliptical hoops of iron projecting about one-half (½) inch, which in turn stick into the mortar coat in which the pavement is bedded.

Time has not yet demonstrated whether the cure is complete, or not, but it is so expected.

Brick and even granite pavements have shown some such motion, rarely serious, but somewhat unsightly.

Much of the published literature concerning pavements was issued before the astounding development of motor-vehicle traffic, which has added enormously to weight, dimension and speed.

This makes steeper grades possible, but calls for wider driveways, flatter crowns, heavier foundations and wearing surfaces which will resist abrasion.

With the changes, steel tires, at least in cities, have largely passed, except for the heaviest vehicles, whose motion is slowest, therefore exerting the least abrasive action and making the minimum of noise.

Segregation of traffic is perhaps somewhat possible in the larger cities, but rarely so in the lesser ones, yet great weight, size and speed is not the monopoly of the larger, hence the problems of traffic census, regulation so far as possible, pavement foundations and suitable wearing surfaces, are essential factors.

In all of these points, capital cost and annual maintenance charges must be given expert study, as well as inconvenience and delay to business and the traveling public from streets frequently closed for repairs or rebuilding.

The lines tempting discussion are many; your committee has contented itself chiefly with suggestions and trust that others will present other facts and thoughts of larger value.

DISCUSSION.

MR. TRIBUS: There may be a little in the way of comment. Last year we had a report on the same general topic, and presented some street traffic figures from Chicago and New York. A committee in trying to gather statistics of this kind is working not so much to instruct—that is not the policy of committees—as to try to gather information and induce communities to look a little more closely into some of the problems, to gather information for themselves and gradually work out the practice for their own advantage. There has been very little done in general in the way of keeping traffic records. In most places they say: "Oh, well, just at present we haven't men that could be spared to do it. It is going to take a week or ten days at least to get anything proper." A traffic census should cover a long period of time and a number of different streets in order to be at all conclusive, and the result is, it is usually passed by. We took this up in one portion of New York some years ago, starting on a Sunday of one week, the following week on Monday, the

next week on Tuesday, and so on thru a period of seven different weeks. We took these figures from six in the morning until six at night, at about eight different typical points. The result was that by the law of averages we got a very fair idea as to movement in the different localities, with the direction and weight of traffic. That of itself is not of much service, unless a census is repeated at another season of the year, and in other years, to ultimately get something worth while. This committee sent out early in the year, to about sixty engineers thruout the country, a set of ten questions. We have been rather disappointed, altho not much was really expected, in the small number of responses. We had as one response, a paper that has been published by itself, (that by Mr. Crosby) because it is rather fuller than a mere answer to questions. We had some other good replies, one from Mr. Goodrich, Consulting Engineer of the Boro of Manhattan, and another from Mr. Pollock, who had been in charge of pavement work in Manhattan. We have some brief but pertinent comments by Mr. Lyman of Louisville. We were very much pleased with the comment by Mr. Conant, Chief Engineer of Savannah, who said: "We haven't anything to report at this time. We appreciate the need of such, and we hope to do better in the future." Well, there is a lot of encouragement in a reply of that kind. It shows that the place is alive, and the man is alive. I will read the ten questions: (Reads questions referred to as printed in the committee's report above.)

The consulting engineers of the five boros of New York organized as a board for conference, but without authority other than formulative and suggestive. For quite a long period they took up the question of proper regulation of street traffic, and gathered statistics from all over the country from the larger cities. Based on the studies they formulated an ordinance, considering that there were two, or perhaps three, factors that should be covered by a system of fee-regulation. The ordinance was prepared, and being published in the committee's report need not be read in detail. It covered a scale of fees on a sliding scale of weights for loads per inch width of tire, running up not to exceed a maximum of one thousand dollars. Then the weights in pounds per wheel, which at first sight would seem to be covered in the first but not when studied closely. No charge for less than 6,000 pounds—from 6,000 to 10,000 pounds, covered by a scale of charges from $75 up to $1,000. Obviously a weight of 10,000 pounds per wheel means a

very heavy total load. With a vehicle having a 5-ton load per wheel, moving on a street, striking a sewer manhole head, the chances are that something is going to go, and it often does go. The course of such heavy loads is marked in many cities by a depressed line in the pavement, by broken sewer heads and crushed culverts. It was felt that if people wanted to move such great loads, they must pay a fee sufficient to repair the damage. Another feature coming in with the motor truck is their increasing width. A street that could normally handle three lines of travel, two in one direction and one in another, would care for practically all old-time travel except in specially busy districts. We take, however, a vehicle that is very wide, and we very quickly have but two lines of travel possible, taking up a great deal more than one-third of the traffic possibility. So the ordinance provided for a license for all vehicles from six feet six up to nine feet six, which would seem to be the maximum for general authorization. Beyond that it was felt there should be special terms and passage only permitted at certain hours. Then, there were provisions made covering the issuance of the licenses and the manner of weighing, and so on. The President of the Boro of Manhattan introduced the ordinance in the Board of Aldermen. The Board was very pleased to receive it and referred it to a committee, where it still remains buried. It was presented on February 24, 1913. It is published in the report. Another item in the report is presented as a matter perhaps of some interest, viz., a grade-crossing case studied in the light of a good traffic census. For years, people have known the crossing to be dangerous, tho well protected with interlocking safety devices and signals. No accident has yet occurred. It is the place, however, where an accident can not occur, that the most serious one sometime will happen. From the result of the census could be figured out a straight economic loss in dollars and cents. During the year ending June 15th, 1915, something over 100,000 street cars crossed the steam tracks, carrying 2,700,000 passengers; an average delay to those cars was three minutes each, conservatively stated, actually, it was a little over. Averaging the gross loss of time with ample deduction for pleasure traffic, Sundays and holidays, it figured an aggregate of something like sixty years loss of time for one worker. Now, I don't mean to say that that necessarily meant the loss of equivalent earnings, because the travelers started a little bit earlier in the morning, and reached home a little bit later at night. But, nevertheless, it meant a loss of time,

even perhaps a normally unproductive portion. Then, all vehicles, of course, were stopped, with a delay of more than three minutes, because the gatemen are in no hurry to raise gates to let ordinary traffic thru, while fairly expeditious in permitting the electric cars to cross. The problem for final solution was to provide an under or over-grade structure, but the point for us is only that of the application of the traffic census. The committee desires to gather such facts together so when any of us have similar problems, we can look right into the proceedings and get the basic data.

Mr. Blair: There is no subject coming before this Society that has been of greater interest to me than this one subject. I do not want to take the time to go into a discussion on the problem at all, but I do want to say this, with all due deference to what has been said. I do not think, that so far, in gathering traffic census data, it has been approached from the right direction at all. I do think that we must as a fundamental basis, upon which to exercise judgment, start with a correct relationship of the thing that is traveled upon, along with what travels upon it. I have just a page and a quarter simply to read into the record, and I want to read it to you so you gentlemen will understand and for consideration of the committee's future activities in this behalf, and I take my cue from Mr. Crosby's statement of the case. He says: "Streets are built for traffic and to know what kind of a street to put down in any particular case in order that the greatest satisfaction may be had, we should know the kind and amount of traffic the pavement will be expected to sustain." We think the case well stated—but we must take issue with the grasp with which the question is presented and accepted for discussion. Merely counting the traffic as to both number and weight will not suffice. We must realize that as to any one kind of pavement as great a variety of value is to be found as there is variety of traffic—or difference in number of vehicles which are driven over certain streets, as well as the weight. For instance, a Medina stone street, tar filled, without any concrete foundation, would soon show great impairment under moderate use, while a block stone street, constructed in the best manner would not be injured for many years tho the travel was many times greater both in number and in weight. So with all types of pavements—they vary greatly in value entirely due to the way in which they are built. Selecting a type of pavement on travel effect alone, would

greatly mislead. Comparing the travel effect on a pavement of one kind, poorly built, with another kind, properly built, would furnish no basis for the exercise of good judgment at all. Manifestly, therefore, comparisons to be of any value at all must include not only the traffic census but also the exact character of the particular kind—if an asphalt street, its exact construction in detail, if a brick street, exactly what it embodies in its building. It is only such information that makes possible a measurement of value and accuracy. Merely knowing the amount of traffic over a road without knowing what in truth and in fact supports the traffic—any conclusion reached is not judgment but a guess.

MR. TRIBUS: I would state, Mr. Chairman, that we are very glad to have this suggestion from Mr. Blair, but the report of the committee last year gave more or less attention to the very point that Mr. Blair has presented to-day, so that it did not reproduce it in this year's report. The speaker has had occasion to lay a considerable mileage of pavements of different classes, and all of the important ones were chosen according to this very scheme of investigation of which Mr. Blair has spoken, taking not simply the number of vehicles, but the class of vehicle and weights, direction of travel, prevailing atmospheric condition, drainage, width of street, gradient, and so on. Then as judgment determined the type of pavement, the character of foundation was considered to hold it intact. The committee believes with Mr. Blair the first object in studying for a pavement is, the wear; the wear is dependent upon the use and care that somewhat depends upon the climate, but the traffic census aids in learning facts.

MR. BLAIR: That is the point I want to bring out. Maybe I have failed to distinguish. It is not due to the wear nearly so much as it is due to the character of the construction. Let me give you just one concrete example. I sometimes use it in this way: Take two streets, one St. Clair Avenue in Cleveland, and one 49th Street in Cleveland—both made of Medina stone pavement; one bears three or four times as heavy traffic for eleven years, which is in perfect condition and getting more perfect every day. The other street is in the very worst possible condition. If I had told you to go there and build a street that is unadaptable to every kind of traffic, why that is the way to build the street. I sometimes say that a team of

horses going along that street are compelled to lift that load one half the way forty-five degrees. The wear and tear on that street is simply fearful. It is known all over the world as a Medina stone street. But that alone has nothing to do with it; a good many things alone have nothing to do with it; but every detail that enters into that street has to do with it. Now, I would have to know exactly how that Medina stone street is built, along with the traffic loads that pass over the street, in the one case and in the other case I think public economy demands that we know as much with reference to the method by which a street is built, to enable us to judge as to what it will sustain in traffic, as to know how much traffic has passed over the street, without this information. Information alone of either kind is valueless; we must be informed as to both.

MR. TRIBUS: Perfectly. I have said, that all comes under the general classification of wear. You have to prepare your sub-grade; you have to prepare your foundation—not alone the wearing coat. I have streets in mind which I would not want to pave, even on a good sub-grade, without a 12-inch concrete foundation. And there are conditions of traffic where there still might be occasional heavy loads going over it, equally individually perhaps to those passing over the 12-inch foundation, where I would consider that a 6-inch concrete foundation was sufficient. I believe that every one of these factors comes in; the road should be planned from the soil to the finished surface.

MR. FOLWELL: Mr. President, we ought to be able to use the data obtained by the traffic census in the designing of future roads—our future practice should be based on past experience—and I have in the past from year to year hoped that the committee would be able to present, at least tentatively, actual figures or statements as to something which has been discovered by some of the censuses which have been taken. For instance, I understand there are numerous records which have been taken in New York City, and I presume some use has been made of them, and I thought possibly the committee could tell us what had been discovered from them, if anything; or if you could not call it actual discovery, what tentative ideas or conclusions have been drawn from those records up to the present time. Also, I was rather in hope that the committee this year might tell us to what extent the idea of taking traffic censuses is being adopted in the various

cities thruout the country, and how many state highway departments and county highway departments were doing some serious and reliable work in the way of taking a traffic census.

MR. TRIBUS: The first point Mr. Folwell has spoken of, the New York Board of Engineers tried to embody in the proposed ordinance—the digested results from its widely and specially gathered information. Taking up the question of the width of paved ways, we found there was very great blocking of traffic in a number of streets, due to even a few vehicles of excessive width. We found there were some streets carrying, regularly, excessive loads. All of these things that were to be guarded against in the ordinance were noted because we had found injury in enough cases to warrant special provisions. The other point that Mr. Folwell speaks of, the bringing of statistics together, is a good one but, as has been reported, out of sixty inquiries sent to leading men thruout this country, I think there were but five that made report, and the committee assumes that in most of the places it was really because they did not have any information to send.

MR. CARPENTER: I think the subject under discussion is a highly important one, and that the reason given for a failure to reply is just as Mr. Tribus has stated, that there are very few engineers or commissioners in charge of street work who have had an opportunity to take any census figures. Our committee on stone block pavement this year realized the necessity of having this kind of information available. The manufacturers of stone blocks requested a modification of our specifications and called the committee's attention to the fact that stone blocks that would not pass our present specifications were, nevertheless, giving satisfactory service in some cities. This immediately leads to the question of street traffic, and at the present time there is little available information as to the amount of traffic passing over the various kinds of pavements in our cities and its effect thereon.

The committee on stone block pavements went as far this year as to divide our specifications into two parts, making one specification for heavy traffic and another for light or medium traffic. Even this is exceedingly indeterminate, for heavy traffic in New York City is not heavy traffic in a city of 50,000; and when we refer to heavy traffic in a city of 50,000 we cannot, or ought not mean the heavy

traffic of New York City. I want to ask this question: Has the committee on traffic census recommended any particular units for the taking of such a census?

MR. TRIBUS: No; nothing more than the report of last year, which suggested the way that was adopted in one of the cases mentioned, and which has been referred to here, of taking it during the season supposed to be the maximum—during the late spring and early summer, thru a period of seven weeks.

MR. CARPENTER: I did not make myself clear. I mean units for the conversion of number and types of vehicles into ton weight.

MR. TRIBUS: No, not specifically. In the New York observations, while there were observations taken of all the vehicles passing certain points at certain times, there were certain ones that were picked out and measured, the weights being estimated in comparison with some actually known; the inspectors could get a fair idea in that way. There were perhaps two or three thousand vehicles thus actually measured as to width and length, with their weights approximated, while in some cases it was possible to record actual known weights of load.

MR. CARPENTER: It seems to me that right here is an important point. We are in the infancy of traffic census taking, I take it, and are realizing year by year that such a census is of great importance. Certainly this Society can do no better work in this line than to try to establish, before a mass of figures are collected which have no comparable values, some conversion units, or methods of changing the census figures representing number and type of vehicle into tons per foot of street width.

PRESIDENT HOWELL: I might say that we have in the city of Newark that very system of unit determination of traffic, and in the last year or so, before a decision is made as to the kind of pavement on any highway, either in Newark or Essex County, we take a traffic census. The City Plan Commission spent some four or five thousand dollars in taking a traffic census of all the leading highways of the city and Essex County. Mr. Reimer, who was present a few days ago, spent some six thousand dollars in taking a careful

census on a number of county highways before he recommended to the County Board of Freeholders certain types of pavement.

Mr. Carpenter: Mr. President, does the method of converting your traffic in number and kind of vehicles correspond with the method used by the Massachusetts Highway Commission, so that your ton weights would be the same as theirs, or does it compare with the English method?

President Howell: I am not well informed as to their method. Our method was something like this: We had careful inspectors take, for a period of ten hours, the census on various streets—I think it was taken for seven days consecutively—and found that the average per foot of width of street of certain kind of pavement would run up to, say a very heavy traffic street, fifteen tons per foot width, on others ten, on others seven and a half, on others five, and on some down as low as two and a half or three. Then we observed, on certain classes of streets of that traffic, how various kinds of pavement operated under different tonnage of traffic, and we were pretty nearly able to fix certain ranges for different types of pavement. For instance, we put down brick or asphalt not running above five tons per foot; then we might allow bitulithic to go up to seven and one half tons per foot; and wood block or asphalt block would run up to around ten, and possibly granite block would run up as high as fifteen tons. A Medina sand stone would probably be able to stand a little heavier traffic than brick. That was our classification to determine the action of traffic on streets paved with the pavements named above, from the known tonnage passing over them at a stated interval.

Mr. Blair: Was there any effort to carry along the information as to the kind, any more than mentioning the type by name? For instance, you named the sandstone streets, but did you give any information as to how that sandstone was built along with the other information?

President Howell: Why, all the sandstone was laid on a concrete base; in fact, all pavements are laid on a concrete base, except some old type of macadam; everything else is on a concrete base. I would like to modify that by saying that some of the old granite pavements were laid on a sand base.

MR. CARPENTER: I wish to drive home this particular point, which seems to me important. Would the census figures of Newark taken at 500 runabouts, 750 limousines, 100 trucks and so many two-horse teams and so many one-horse teams, work out to the same tonnage as the same number of vehicles counted by the Massachusetts Commission or by some other commission? That is my point. It seems to me it is going to prove important in future in comparison of the effects of certain kinds of travel on roads.

PRESIDENT HOWELL: In answer to that I would say that our traffic census would probably not apply to any other city, except with a similar traffic over the street.

THE TRAFFIC CENSUS AND ITS BEARING ON THE SELECTION OF PAVEMENTS.

By W. W. Crosby, Consulting Engineer, Baltimore, Md.

Streets are built for traffic and to know what kind of a street to put down in any particular case in order that the greatest satisfaction may be had, we should know the kind and amount of traffic the pavement will be expected to sustain. This may seem a trite statement, but upon investigation it will be found rather astonishing how many selections of pavements have been made in the past without proper regard for the traffic to be considered. The writer thinks that not only his repetition of the truism is justified, but that even wider emphasis than has been given in the past to it is and will be justified for some little time to come.

What the traffic will be on a new street or a new pavement, which is an improvement over previous conditions, may be difficult to estimate accurately. Nevertheless such an estimate should be made and the basis for such an estimate is necessarily the present traffic over the street or over a closely adjoining and parallel street.

We therefore come to the traffic census or the present use of the street as a point of beginning, and naturally questions arise as to the best practicable methods of recording the present traffic. The determination of these methods is fixed by (a) the consideration of the effects of various kinds of traffic, (b) by the amount of traffic to be counted, (c) by the abilities of the observers available.

(a) The differences in the effect of traffic are often lost sight of in taking and recording traffic censuses. Merely counting the number of passing vehicles is now generally recognized as insufficient to give a correct idea of the effects of the traffic, and the tendency is to separate the count into different classes of vehicles. In some cases, this separation is carried to an extreme and the number of classes of vehicles made so great as to bring about difficulties in recording without, at the same time, compensating for this extra work and resulting confusion by furnishing additional information of value for the solution of the problem. In some cases, the number of classes established seem insufficient to give the information desired. The effects on the pavement of two-horse, hard-tired vehicles, lightly

loaded, are rather different from those of two-horse, hard-tired vehicles heavily loaded, and, of course, again different from those of one-horse vehicles. On the other hand, it seems probable that a relation may exist, which may be quite nearly in proportion to the weights, between the effects of one-horse and two-horse hard-tired vehicles. In both these cases, usually the effect of the horses' feet is more serious than the effect of the load and the weight, though in cases of extremely narrow tires, this may not be the fact.

The considerable effect of traffic drawn by more than two horses is, in most cases, more likely to be that of the load transmitted through the weights and tires, and this is recognized by the classification generally adopted which accumulates the count of such traffic under one head "hard-tired vehicles drawn by three or four horses."

The effect of motor traffic is quite different from horse-drawn traffic. Recognition of this fact is now quite general and is evidenced by the separate recording of the traffic count. With motor traffic the weight is, of course, a large factor in the effect produced, and it seems necessary to classify separately the motors differing greatly in weight. Another factor, however, which admittedly is large in the effect produced is that of speed, and sufficient consideration in the traffic records to date does not seem to have been given to this factor, while possibly too much of an attempt has been made to refine the traffic records, rather unnecessarily in some cases, by establishing too many classes for the motor traffic. It is quite likely that such a classification embracing

a. Runabouts, light touring cars, and light delivery wagons;
b. Taxicabs, heavy touring cars, limousines;
c. Drays, busses and trucks;

(all with rubber tires) would be sufficient. These could be counted separately, their average weight and speed estimated, and their momentum (the basis for the effect in each case) could then be calculated with sufficient accuracy.

Most of the discussions, so far published, on the effects of traffic, seem to the writer to have neglected to an unfortunate extent this matter of the speed of traffic, and some highway officials have gone so far as to state definitely, bases for the comparison of traffic which they say are "excellent" or "satisfactory," and which are simply the

result of the calculation of the tonnage per mile, or per yard or foot of width, but which do not take into account at all, the speed of transportation.

It will not be denied by experienced highway authorities that the speed of motor traffic has an important bearing on the effect of such traffic. A ten ton load propelled at a rate of five or six miles per hour produces mainly an effect of compression or toward vertical displacement. The same load propelled at 15 miles per hour sets up horizontal strains of considerable moment. The same facts exist in the cases of considerably lighter vehicles. Delivery autos traveling at the rate of 15 miles per hour do comparatively little damage to even water-bound macadam, but if traveling at 30 to 40 miles per hour, they render the water-bound macadam entirely unsuitable for sustaining such traffic. The writer has noted a change in the average speed of traffic on certain roads, where records covering a period of ten years were available, and has shown from these records that the average speed in these cases had increased during the past ten years from 50 to 100 per cent. It is unquestionable that the present faster traffic is much more severe on the roadway surface than the earlier traffic. Yet without consideration of the increase in speed, the reasons for this greater severity would not be entirely clear. The writer feels that it is extremely unfortunate that authorities like the British Road Board, the U. S. Office of Public Roads, the Massachusetts Highway Commission and the "Engineering Record," should lend their prestige to a public statement, in effect, that the ton-mile basis is a proper one for the comparisons of traffic, neglecting entirely the speed factor.

As a matter of fact, is not the comparison to be made that of the yearly cost per square yard per ton (or thousand tons) of traffic in which first cost of the pavement distributed over the years of its life, the average annual maintenance cost, and the tonnage of the traffic carried during the life of the pavement are properly figured with the inclusion of consideration of the width of the pavement, tonnage per year, proportion of tonnage on metal tires, proportion of tonnage on extremely narrow tires, and the speed of the traffic, and then the cost figure, so arrived at considered in connection with the other advantages or disadvantages of the particular pavement in question, from the other viewpoints, which go with the cost to determine the satisfaction of the pavement for the locality?

(b) The amount of traffic to be counted will to some extent at least affect the determination of the records attempted to be secured. It would be difficult, if not impossible, to secure on Fifth Avenue, New York City, for instance, as refined a record of traffic as could readily be secured on a minor country road. It is desirable, of course, that the traffic records obtained shall include all the necessary information and as much further information as may be of enlightening value. It is also desirable, for many reasons, that a standard form of traffic record be generally adopted. However, the minor differences in effect between various kinds of vehicles decreases in importance with the increase in number and variety of traffic. It would, therefore, seem to be quite sufficient to establish a standard form of comparatively simple classification for use on the heaviest traveled streets, which could be further elaborated, by sub-divisions where so desired, for use in particular cases where the frequency of traffic was not such as to preclude the possibility of obtaining information on the minor points. The segregation of a traffic count on Fifth Avenue into numbers and classes of vehicles moving north and south would be difficult and of doubtful value in studies affecting the selection of a pavement for this street. On the other hand, in the case of some market roads leading into a city, the selection of a roadway surface might be materially affected by the fact that the units of traffic follow each other closely in single lines for short periods near the beginning and end of each day as is quite frequently the case.

(c) The average abilities of the observers usually available will affect the decision as to the form of record of traffic to be attempted to be secured. Such records are seldom if ever made personally by engineers capable of appreciating the minor differences, and are usually made by low salaried employes. It is obvious that the form of records should not be such as will conduce toward inaccurate or misleading figures. The foundation on which the ultimate solution rests and from which deduction after deduction must be made, will be at best too narrow and imperfect to justify any chances being taken toward its further weakening by confusion or inaccuracy during its construction.

At best, comparisons of existing traffic are purely relative and demands on the future traffic necessarily more so. Refinement and extreme accuracy in the matter will for a long time be impracticable if not impossible, but great improvement unquestionably can be had

by general agreement tending toward greater uniformity and, ultimately perhaps, providing a fair degree of standardization. In making comparisons and determining relative values, such an agreement as to a form for traffic records will be of the greatest possible assistance to highway authorities for a better deduction than now generally prevails in practice of that important question "The proper selection of pavements for particular cases."

The writer has not thought it necessary to argue to this audience the value of the comparisons of traffic in connection with the selections of pavements, but has merely attempted to point out some of the difficulties in the way and to emphasize perhaps what appears to him to be the necessity for careful, and as things are at present, unusual consideration of some of the factors in this connection. The American Society of Civil Engineers has, through its Committee on Road Materials, attempted to assist toward the uniformity in traffic records above mentioned as desirable, and the Committee has made some suggestions in the matter, (see report of Special Committee on Road Materials, A. S. C. E., presented in pamphlet form to the Annual Meeting, January 20th, 1915, pages 3003, 3022, 3031 and 3033), and would be pleased to consider any discussion, suggestions or criticisms tending to improve this report in this matter.

THE RELATION OF TESTS AND SPECIFICATIONS TO THE USES OF MATERIALS.

By Benjamin Brooks, Kansas City, Mo.

This is not strictly a technical paper. It has to do with the policy and the position of an engineering society rather than with a particular process or a particular material.

Our society, as I view it from the standpoint of a new member, is principally concerned in studying what are the requirements of a municipality; also in studying certain methods and materials, not for their own sakes, but as a means of meeting these municipal requirements. We study garbage disposal, not for the sake of the garbage but to make the municipality clean. We study problems of illumination and transportation, not for the local light and power company, but to make the municipality pleasant and convenient. We study sewers, not because we relish them, but to make the municipality safe and clean to live in. This relationship between materials and the objects to be obtained by them is perfectly obvious to you, but I mention it at some length because the relation is forgotten with surprising frequency.

In an association composed entirely of manufacturers it is natural that more attention should be given to the successful sale of the manufactured articles than to the manner of their use or the objects they attain. In an association composed entirely of engineers, no interest exists in the sale of materials, but those whose business it is to write specifications for them and prescribe tests, often find the materials so extremely interesting on their own account, and the methods of testing and measuring their several characteristics so engrossing that they unconsciously lose sight of the final objects to be attained by their actual use.

Now in a society such as ours, where both engineers and manufacturers work together, there is far less tendency for the shortsightedness which I describe to exist; yet even among such joint societies many instances may be cited where tests and specifications do not match with objects sought, and I should like to call a few of them to your attention.

A few years ago at a great meeting of the International Association for Testing Materials, a German engineer presented a method of procedure and a series of tests for measuring and defining the several characteristics of rubber. His work had been done with the characteristic German thoroness and involved experiments, if I remember, upon some fourteen hundred specimens. The Association received his paper with great interest, but scarcely had the applause died away when a young American engineer with red hair and a practical turn of mind rose to his feet and began to ask the German expert a series of impertinent questions which in a very few moments brought out the objection that, although the rubber expert had spent years studying rubber, there was nothing in his method of testing it which would enable a purchaser or user of rubber to select the grade or the quality which would fulfill his particular requirements.

A little more recently a committee of the American Society for Testing Materials held a meeting to formulate a specification for a certain class of brick. In this committee were included some of the most distinguished ceramic experts, most successful manufacturers and most skillful testing engineers. I was present merely as an invited guest, to look on. The method of procedure, roughly speaking, had been to select a number of typical brick, to test them, and then to write specifications, not according to their *use,* but according to these *tests*. No sooner were the specifications written than a member called attention to the fact that they excluded a certain quality of brick which he had been successfully marketing, and which had already lasted under the severities of a New England climate without sign of failure for over two hundred years.

There was no way of disputing him nor of justifying the specifications against such practical criticism, because they had been written not in accordance with the purpose of bricks, but from mere laboratory tests upon them.

A few days later, in another committee of the same society, we were discussing the matter of sewer pipe. Two kinds were under consideration. The proposal was first entertained of writing different specifications for the two different materials, altho they were both required to fulfill the same purpose and meet the same demands; but on having the inconsistency of so doing brought to their notice, the engineers representing both materials, tho competitors in one sense, agreed to get together and write a specification for *sewer pipe*

whether it was made of cement, clay, glass, infusorial earth or what not.

Now this matter of sewer pipe, beside being a very important one in municipal affairs, is the one which has of necessity occupied most of my attention. It was on both of these accounts perhaps that I recently wrote the secretary of that society asking him to explain to me why on one page of the Society's Year Book the allowable porosity of sewer pipe, as measured by weight of water absorbed was set down as 5½ per cent, and on another page as 10 per cent. He was apparently much surprised at such a question. "Why," he replied, "you cannot have failed to observe that in one case the specification is for vitrified clay pipe and in the other for concrete pipe, and surely you could not reasonably expect the absorption on concrete to be as low as on vitrified clay."

Now, as a matter of fact, he was mistaken. The absorption on the best quality of properly made concrete pipe may easily be as low as on the best quality of clay pipe, so that I am thereby absolved from entertaining any foolish notion of endeavoring to do away with any competitors; but I recall to you my question and his reply because they serve to illustrate so clearly that the writers of the specifications had in mind the materials rather than the requirements they were to meet. In another part of these same sewer-pipe specifications is a similar instance of a disregard for the final objects sought. I refer to the testing of sewer pipe by dropping a ten-pound weight on it from a certain prescribed height. This is a good measure of a pipe's ability to withstand impact; but sewer pipe is never properly called upon to withstand impact. Specifications governing methods of placing earth around and over it prevent any impact. Some pipe will pass this test, some will not; but, generally speaking, the harder and denser and more sanitary and serviceable a pipe is in actual service, the less likely it is to stand having weights dropped on it.

But bear in mind that this is not a mere manufacturer's argument to tighten up specifications or to make them lenient. It is a more broad-minded request to consider making them *appropriate*. It involves much more than mere materials of construction. It affects the results attained by such a society as ours, and its standing with our cities. There is an element of great responsibility in it. Once having gained the authority which we deserve, a mere stroke of

the pen may determine the condition of entire communities—their safety, their health, their prosperity.

We see a little glimpse of this feeling of great responsibility cropping out in the American Society for Testing Materials at a time when the whole country was exercised over the breaking of steel car rails. In the face of all the standard specifications that existed at that time, Mr. Henry M. Howe took the courageous stand expressed by the following quotation from his paper:

> "For a preventable death, for a death which I can prevent but do not, I am accountable. In that I do not prevent it I permit it; my omission to prevent, my effective permission, determines the death.
>
> "We set up standards for rails. It is strongly suspected and at times asserted that the breakage of these rails causes many needless deaths. If those rails are bought under our specifications, and if those specifications do not fully secure the very least attainable danger of breakage, we, as the experts on whose judgment these rails have been permitted, thru their breakage, to kill our fellow-men, are in a measure responsible."

If this feeling of responsibility in writing specifications to serve ultimate objects instead of dealing with mere materials was so evident in the matter of car tracks on which the traveling public depends for safety while they are in motion, what shall we say of sewer pipe on which the entire stay-at-home population of the country depends for its safety every hour of the day and night?

I repeat that sewer pipe has been a matter of especial interest to me of late, but owing to its importance to a municipality at large, it is possibly not asking too much to invite our society to review and possibly to modify its policy in writing specifications for this commodity among others so that sewer pipe can be manufactured and sold on a uniform and consistent basis, made strong enough to carry its earth load, smooth enough to carry its water, dense enough not to leak typhoid into neighboring wells or to absorb destructive substances, and used in a way that does not require it to be a target for blacksmith's hammers.

REPORT OF COMMITTEE ON MUNICIPAL LEGISLATION AND FINANCE.

By A. R. DENMAN, Chairman, Newark, N. J.

Your Committee on Legislation and Finance finds itself in much the same position as the Committee of last year. It is believed that the application of law to municipal government and finances is a progressive one, which under our American institutions must, of necessity, be more or less gradual in its development. Commission forms of government and special charter legislation of a radical nature are still somewhat in the experimental stage. The tendency has been, and rightly so, to centralize and to a much greater degree, give more power and authority to the executive, and remove the administrative officers further from political control than was formerly the practice. One feature of recent legislation along this line, which is also to be commended, is the formation of Boards of Estimate which embrace, together with the executive, the heads of the various administrative departments rather than placing the whole burden of the determination of the amount of the necessary funds to be raised for the city government in the hands of the legislative branch. It is certain that the needs of the several departments are better known and understood by their administrative heads than by the Council. By placing the burden and responsibility upon such a Board of Estimate the needs of the several departments or agencies of government can be adequately presented to such a Board, and the importance of special conditions which may exist in one department for the time being can be passed upon by men who would more thoroly realize the relative importance of the various activities of government, so that the result should be that the more immediate necessities and the more urgent work would be given precedence in the adjustment of the budget. It might also be noted that this more or less new department has resulted in budget exhibits, and in giving the general public and the people who pay taxes a much better opportunity to know just how the moneys raised by taxation are distributed.

The concentration of population in the municipalities is still continuing at a rapid rate and the debt caused for the necessity to adequately provide for such concentration seems to be running up the taxes in all the cities. Present administrations have been resorting

to bond issues. These as a rule carry sinking fund provisions, but the time of reckoning has arrived. Many cities have about reached the limit and some have actually pledged their credit to a degree beyond wise administration. Certainly no bond issues should be made for any improvement, the term of the bonds for which would exceed the life of the improvement. The issue of long time bonds for the construction of pavements is a sample of mistakes of this character.

Your Committee would call attention to recent investigations which seem to point to the advisability of paying off bond issues in annual installments rather than by the sinking fund method. It would seem, however, that if sinking funds are well invested that the two methods are practically the same in actual cost. The total amount of money paid out in either system is practically the same, for in paying off in installments on a 30-year bond will be paid one-thirtieth of the issue each year and the interest charges will gradually be reduced so that at the last year there would be paid only interest on one-thirtieth of the total issue, whereas at the first year is paid interest on the whole sum. Such a method applied to a pavement, for instance, would seem advisable (except that in the case of a pavement bonds should certainly not run for more than twenty years). The higher payments made during the first years would be while the pavement was in its most serviceable condition. However, when you apply the same method to the installation of a water supply, which would be built to anticipate the needs of a city for thirty years, the reserve earning capacity of such a plant would make it advisable that the heavier charges for the discharge of the bond issue could better be made during the latter part of the life of the bonds than at the beginning when the revenues from such new plant would be at their lowest. It may, therefore, be suggested that it would be unwise to entirely switch from one method of discharging bond obligations to another, and that one system might be of advantage for certain improvements and the other system more consistent in another case.

It is thought advisable to invite attention to the very conservative attitude taken by certain financial institutions and bond houses at the time immediately following the outbreak of the European war toward the issuing of additional municipal bonds, on the ground of the stringency of the money market. At the present time such

stringency does not exist, while the ultra conservatism of these institutions apparently prevents a public announcement or other means being taken by them to restore the normal conditions regarding municipal financing. This allusion is made in the hope that some adequate relief may be had under the circumstances.

In the crowded metropolitan cities it is coming to pass that the fund raised by normal taxation, as now conceived, is not and cannot be sufficient to meet the ever increasing expenditures demanded by the requirements of the modern city. It, therefore, becomes an imperative duty to provide for this situation, by securing as many other sources of revenue as possible to relieve the increasing burden of taxation without curtailing municipal development, and to this end the exploitation for personal aggrandizement of the revenues produced from municipally operated public utilities should be discouraged, and these public utilities and all other revenue producing properties owned by the municipality should be operated as a business and reasonable profits received therefrom applied to reducing the public burden. And one phase of legislation having for its object the establishment of the principle of excess condemnation in the carrying out of municipal improvements would seem to be in direct line with the foregoing thought, by materially reducing the portion of the cost of street openings, park acquisitions and similar takings of land for public improvements which otherwise would fall upon the municipality itself.

THE LAW AND PUBLIC WELFARE.

By Dr. D. Frank Garland, Director of Public Welfare, Dayton, O.

It is written in the preamble of the Constitution of the United States that it is the business of the government to promote the general welfare. This provision of the constitution, therefore, regards the state as a social institution existing for the people and charged with the duty of promoting their common welfare.

The great state of Ohio has written in her constitution this definite provision: "Laws may be passed fixing and regulating the hours of labor, establishing a minimum wage and providing for the comfort, health and safety and general welfare of all employes; and no other provision of the constitution shall impair or limit this power."

Blackstone's definition of law suggests its function. "Law is a rule of civil conduct prescribed by the supreme power in a state commanding what is right and forbidding what is wrong." The law is the expressed will of the people; and being so it becomes an index of public opinion. As this opinion and will of the community are not a fixed quantity but subject to change with changing condition and circumstances, in like manner must law be a growth, never to be regarded as a fixed and determined thing. Legislation therefore which expresses the dominating purpose of the community must accordingly be a mobile and adaptable instrument. The law reflects the stage to which the community has advanced in the regulation of its own affairs. The law therefore is a growth. It has its roots in the past and it grows with the experience of men. It accommodates itself to an awakened and enlightened public conscience. This is a fact of history.

The law is constantly adjusting itself to new social and economic conditions. It is perfectly clear that in a democracy ideals of righteousness so far as the body politic is concerned can be carried out only by legislation.

It is sometimes urged against the effort to promote the public welfare thru legislation, that a man cannot be made righteous by the legislature. This is true, but he can be made to act righteously

in his public social relations and so be compelled to contribute to the common good. We must never lose sight of Spencer's formula of justice, "The liberty of each limited only by the like liberty of all." Society is made up of a multitude of individuals, the well being of each of whom is dependent upon that of others. Legislation therefore is an absolute necessity in the promotion of the common good.

Changes in Social Legislation.

Law was at one time, only a guardian of special privilege. A distinguished writer in illustrating the use to which law was applied in that day, puts this complaint in the mouth of the peasant: "I sow corn, and partridges eat it. I attempt to defend my corn against the partridges, and I am arrested and fined and sent to jail—all this for fear a great man, who is above sowing corn, should be in want of partridges." In this period social justice was denied and special privilege was protected. The law now is a weapon not to guard special privilege but to insure the greatest good to all.

Industrial development, invention, discovery, the advancement of knowledge and science have created wholly new conditions of life. A new world has come into being and we have witnessed as a result, the most marvelous economic and social changes ever registered in the history of time. The opinion of the public forced legislative action to meet social and economic stress and strain which threatened the very existence of industrial nations. Early in the last century in most of the leading nations of Europe freedom for the individual in the enjoyment of equal political rights was achieved. When this result had been attained, everything seemed to have been gained, but it was soon found that this was but a step in the way of complete emancipation. Widespread misery still existed. England, for example, found that the masses of her people were herded together like cattle in the slums of great cities where air and water were luxuries. America found later in the last century, like conditions in her great cities. We found one-third of the world still underfed, eighteen per cent of the little children in a great wealthy city like New York, coming breakfastless to school. We found every winter more than a quarter million working men and women idle in this same city with the consequent misery and suffering which follows. We found a growing army of dependents, of insane, of feeble-minded, of moral delinquents.

Pauperism, crime and physical degeneracy forced themselves upon the attention of society as our state institutions became more and more crowded, as our death-lists from preventable diseases grew longer.

We saw that every year more than 10,000,000 of our people were injured under the driving wheels of industry and scores of thousands were killed. We saw that in our mad rush for material good, one-fifth of our new-born babies never lived to reach their second year. Protest against the inequalities, and iniquities of a system of life that brought such a harvest of loss and bitterness in its wake became more and more pronounced and legislation to correct these social wrongs was called into service. The old notion that society ought to leave its members alone, each to look after his own several interests, provided he does not employ direct fraud or force against his neighbors, now came to be regarded in the language of Thomas Arnold as, "One of the falsest maxims that ever pandered to human selfishness under the name of political wisdom." This changed conception of the duty of the state under the stress of the new social movement led to an effort to socialize the law that it might be made effective to secure not alone individual justice, but social justice as well. The law now is conceived to be an agency for securing by common methods, common benefits to all. This movement is just beginning to make itself manifest in our land in a large and comprehensive way, but I am persuaded it is a movement like a river flowing on resistlessly towards a better human fellowship in life than has ever been known. Let us mark some of the stages in the progress of law in an effort to promote the public welfare.

Stages in Social Legislation.

Social legislation concerns itself in this new era of progress with labor, health, safety, food supply, dependent classes, family relations, prevention of fraud, discrimination, conservation of the nation's resources, freedom of contract, limitations in the use of property, limitation of the parents' rights in their children, etc.

1. Under the old common law which failed to meet the new conditions arising out of the industrial development of the last century, courts found themselves often unable to apply the law to meet the new social needs with respect to liability for accidents in the field of labor. For a time courts sought by interpretation to broaden the

power of the law, but at last, failing generally in this effort, public opinion demanded new legislation to meet the new situation and needs affecting the laborer in the operation of the machine.

2. New laws have been enacted affecting factory conditions, all of which have to do with health, safety and comfort of the workers.

3. Laws have been passed which limit the freedom of contract, with respect to payment of wages, regulation of the hours of labor, the conditions of labor, that no employe can release his employer from liability in the case of accident, that no employer can forbid membership of employes in labor organizations, that women and children may not engage to labor in certain lines of work, and children under a certain age may not sell their labor in any market.

Thus you see the old age doctrine of free contract has been superseded by the new doctrine that the State in the interest of the public welfare can regulate and should regulate contracts for labor and control terms of employment.

4. In the matter of unemployment we have but made a beginning towards a solution of this serious social problem. It is in some measure overwork which causes unemployment and in this measure at least some states have passed laws fixing eight hours as the maximum day's labor. Many states limit the working hours of women and children. The National government within a year has created a Federal Bureau on Employment and the time is here when we in this country must take the same position Bismarck took when he said that it is the state's duty to provide work for every healthy man who can find no work. And I make bold to state that it is equally the State's duty to compel every healthy man to work who, because of moral obliquity or laziness, prefers not to work.

5. We have limited the power of the creditor to secure satisfaction from the debtor. The time was, not so long since, when Dayton had a cell in her jail called "debtor's cell" but no one can now be imprisoned for debt. We have gone further and have exempted personal property in a fixed amount from liability for debt, and have placed tools, animals, implements and the major portion of wages in the list of exemption from the collector of debts. Under present legislation both the creditor and the debtor now take a share of risk in the interests of public welfare.

6. We have entered the sacred domain of the home with social legislation in the interests of public welfare. We now limit the rights of the parent in his own child. He could starve the child or beat the child into insensibility, but now we take the child away from the parent and make the state its foster parent whenever we find it to be to the interest of the child and society to do so. Likewise in regard to the conveyance of property, we now require that the wife join the husband in conveying the family home, or in the execution of a mortgage on personal property, or on the assignment of a portion of the wages of the husband for debt.

7. The State has gone further and entered the domain of public professional life, requiring some evidence of skill, some standard of qualification as a condition precedent to engaging in the practice of medicine, dentistry, pharmacy, veterinary surgery, etc. Stationary engineers, plumbers and even barbers are brought into this category. The list is growing, as witness the passage of a law in Ohio last winter requiring the registration of all public health nurses. In the interests of public welfare law steps in between the man or woman, bent on exercising the natural right to gain a livelihood by honesty and industry in the arts, sciences and professions and by social legislation says, "The public cannot know whether or not you are fit and qualified to serve them unless the State acts in its behalf."

8. The public and quasi-public business field in such lines as hotels, warehouses, express companies, gas and electric light companies, banks and insurance companies has been entered by the law-making body in the public interest to insure safety and health and morals, and to protect from fraud and imposition.

9. Law has been unusually energetic in the United States in the interest of the public welfare in the field of penal legislation. The theory of retribution has been given up and reformation is now the objective in imprisonment. Separate courts have been established for different classes of offenders, and separate detention homes have been provided and also prisons. Psychopathic institutes have been established to study the delinquent and measure the scale of his intelligence in order to fit the treatment to the need of the offender against the peace of society. A parole system and an indeterminate sentence law have been provided in a number of states in the interests of social justice and the final welfare of the broken members of society.

The Public View of Social Legislation.

No evidence has yet appeared to prove that the public is doubtful of the efficacy of this effort at broadening of the law to meet new social conditions. The public seems to believe that law is not merely an instrument to insure equal freedom to the individual, but that it is also a power to promote the public welfare, to attain social ends. We are not the free individuals now we once were in this land of the free. We find ourselves limited, restricted, denied, interfered with in the exercise of our individualism. But when we realize what these restrictions and denials and interferences have for their object we are willing to surrender our so-called individual natural rights in order that the larger good may be insured and social demands be met. It cannot be denied that the law has proven to be a most powerful agency to promote the social and economic development of the race in this new and wonderful age in which we live. The increasing dominance of social ideals in all our American life assures us that the public view of social legislation is a favorable one, and therefore that there is not likely to be a stop in social welfare legislation, but rather an increasing impetus to it. These ideals will not easily die for they are insistent in their demands for realization. The facts of life as we are daily learning to know them, the knowledge that social conditions which are hurtful are remedial through co-operative social action, which means in large degree through legislation, these will ever impel us onward to a realization of that better social state lying just ahead.

The law can promote the public welfare if in all social legislation the effort is sought to insure justice as Willoughby describes justice to be. "Justice," he says, "consists in granting, so far as possible, to each individual, the opportunity for a realization of his highest ethical self and this is founded upon the general duty of all in pursuit of their own ends, to recognize others as individuals who are striving for and have a right to strive for the realization of their own ends." To balance individual needs with social needs is not always easy; it is always difficult. To provide for the greatest possible self-realization consistent with the common good is not easily accomplished; but it is a worthy end, a social ideal worth striving for and this is the noble task, the ultimate goal which American social legislation has set for itself in this beginning of the twentieth century.

Continuing Progress.

We will never reach the goal. We will never fully achieve our ambitions. We will never finish what we have begun. New and changed conditions of social and industrial and commercial life will always create new demands and so we will ever be going forward, and may we hope on right lines, towards the realization of an even higher standard of social justice, the common welfare of all. We may never reach our constantly advancing ideals, but we "will see that the flag of the conqueror is never lowered upon territory once annexed" by the operation of law in the promotion of public welfare.

THE DAYTON PLAN OF GOVERNMENT.

By HENRY M. WAITE, City Manager, Dayton, O.

I had hoped there would be so much discussion by this convention of what we are trying to do in Dayton that the few remarks by myself would not be necessary; but the program which has been prepared, I presume, has afforded very few of you the opportunity or time to investigate the details of our government. I shall make my remarks just as brief as possible, knowing that many of you are now anxious to get away, and there are other papers to follow, and if there is any interest in the subject, let it come out in the form of questions that you may desire to have answered.

It may be of interest to know that the Dayton form of government was originally started previous to the flood. A charter commission had been appointed, and was drafting a charter, and they were proceeding with the acceptance of this charter when the flood occured. The dismal failure of the government in charge during the flood was probably a very strong incentive in establishing the new form of government. There has been, of course, a realization for a number of years, and attempts have been made in various parts of the country previous, and as early as 1876, to try a centralized authority in municipal government. I believe in my own mind that the real awakening to a change started in municipal governments after Ambassador Bryce wrote "The Commonwealth." American people have a great respect for Mr. Bryce and his opinions, and I think that the American people would stand more of his criticism probably than any other foreigner. There started with this book a more general centralization at least of authority in municipal government. The first radical step, of course, was by Galveston, which started the commission form of government. But the commission form of government had not gotten away from all of the faults of the federal form of government. There have been modified forms of federal government. We have gotten away, almost all over the country, from a dual chamber to a single chamber of the council, in municipal affairs. But the commission form of government had two glaring faults, which are being proven. First, a mixture of the administrative and the legislative functions, and again, in the fact that in the commission form of government you are still attempting to select thru the ballot a trained official for a particular

function of government. Both of these have proven stumbling blocks in the old federal form of government. The legislative functions and the administrative functions are distinctly divided, and there is no attempt to select thru the ballot trained officials for particular functions of government. In the Dayton plan there are five commissioners elected at large on a non-partisan ballot. These five commissioners select a manager. The manager is responsible to the commission, and he is responsible in return for his organization. In the Dayton plan, there are five departments, at the head of each of which is a director, appointed by the city manager. The five departments are welfare, finance, law, safety and service. It might be interesting to know the type of men who were selected for these five directors. In the first place, the manager coming into Dayton a stranger was not familiar with the material available in Dayton for the five directors, and naturally he consulted the commission as he would a board of directors, and the commissioners furnished the manager lists of men whom they thought had the capabilities for the particular functions of government which they were to fill. The manager selected from those lists the man whom he thought was the one he desired as a director. The director of law, which is the city attorney, was the man who had been on the original charter commission, practically wrote it, and was familiar with all of the things in it, and knew the reasons why certain things had been left out of it, and he accepted the position of director of law. He served one year and then, on account of his large practice was compelled to resign. His first assistant was then selected as his successor. The director of welfare, who has charge of the recreations, the parks, and play-grounds, and correctional institutions, the health department, and the general welfare of the city, was a minister, but a man who spent considerable time and study on social conditions in this country and abroad, and had his feet square on the ground. The commission could not recommend anybody for service director, and advised the manager to go out of town for that position. After the manager satisfied himself that this was true, he did go out of town and selected an engineer, whom he knew, as service director, he having charge of all engineering, and construction work, repair work and the collection of rubbish and garbage, and the water works. The director of finance selected was a man who had been purchasing agent, treasurer, auditor and accountant. He was a public accountant when he was selected as the finance director. He has charge

of the auditing and the treasury and the purchasing departments. The commission could not recommend anyone to the manager for safety director. It was the desire, however, of the manager to select someone as a director of that department, either from the police or fire departments, and rather than again go out of town, the manager himself took over the duties of safety director, hoping that it would be possible to develop someone from one of the departments, and it has been accomplished, as such a safety director is now appointed.

I can not tell to-day the political faith of any of the directors, The game of politics is absolutely not in the government. The manager has full control and full responsibility for the organization, and the result of the organization. The commission sit as a legislative body and pass the necessary legislation, and instruct the manager what they desire to have done. They are the policy governing body. By the charter the directors and the heads of the various sub-divisions, are not under civil service. They are all appointed by the manager. The civil service law, however, in the charter is somewhat different than the federal and as adopted by most other cities, in that the civil service board submits to the manager the complete certified list, and the manager may select anyone whom he desires from that entire list. It does not come up in threes.

This gives you briefly the organization and the result of centralized authority in the selection of the heads of the various departments. There is never any attempt by the commissioners to control the manager in any way in making appointments. The commission leaves the manager alone; he is responsible, and stands or falls on the record which he makes with his own organization. The manager sits with the commission, the same as he has sat before with boards of directors, and he works with the commission the same as an executive in any corporation would work with his board of directors—taking their views, of course, in cases of policy or in case the manager believes something should be done which might be radically different. That is all gone over and threshed out the same as you would with a board of directors, working together as closely as possible; but the line of demarkation, as you see, between the legislative function and executive function is very clearly and definitely fixed. I do not want to bore you with any more details

of the government. I would rather, if there are any questions, open it for discussion, which might show if there is any real interest.

DISCUSSION

Q. Are all meetings public, or do you have executive sessions?

MR. WAITE: All meetings are public, but of course sometimes we get together informally.

Q. How is your budget made up, first, by whom?

MR. WAITE: The budget is made up by the manager and submitted to the commission, first, several months in advance of its final adoption. It is published as submitted to the commission, and the commission read it, and it is then given a public hearing, after which it is legally published, and more hearings given, if desired. Usually, we have one large hearing, and then several small hearings on the budget.

Q. Do you place in your annual budget, the budget of the previous year?

MR. WAITE: Yes.

Q. It is easily available?

MR. WAITE: We always, in the original budget, use a comparison with the year before; that is, we submit it to the commission, and that is published in that manner.

Q. The city manager or the heads of these bureaus or departments are appointed for no definite term?

MR. WAITE: No.

Q. But are chosen from men well qualified for the position? Now, is it provided that they shall be chosen as men well qualified for the position, or is that just worked out in practice?

MR. WAITE: No, the charter states that they shall be men well qualified.

Q. Do you consider, sir, that it is an advantage in electing the commissioners? Do you consider it an advantage, in having no mayor?

MR. WAITE: The commissioner receiving the highest number of votes is mayor and presiding officer.

MR. HOWARD: I think we are pretty well in accord with you, then.

MR. WAITE: Go as far as you like. The further you go, the more you will like it.

MR. HOWARD: Now, as to electing a mayor as the chief executive of the city, he will not sit with the five commissioners, that is, the legislative body, the mayor practically is the city manager.

MR. WAITE: You did not follow us very closely there.

Q. Now, who has the power of removal or suspension of these directors of departments?

MR. WAITE: The manager.

MR. HOWARD: In some cases we are thinking of providing they can have ten days to defend themselves. Is that a provision of your charter?

MR. WAITE: No, sir.

Q. The directors have the right of discharging, don't they?

MR. WAITE: Yes, sir.

Q. What department is your civil service under?

MR. WAITE: Under the commission direct; appointed by the commission.

Q. That is, a separate commission, practically, of three men?

MR. WAITE: Three men.

Q. Do you have the initiative, referendum and recall?

MR. WAITE: All of them.

MR. HOWARD: We have a city of 400,000, and it was too hard on any one man to make him singly the city manager.

MR. WAITE: I cannot quite get the drift of your remarks. You might just as well say you could not apply to an entire railroad system the same organization you apply successfully to a division of a railroad, because the particular form of government which we have here is purely and simply the same organization that we

have in large corporations, and, of course, you have to sub-divide it into units of organization.

MR. HOWARD: Of course, where there are expert managers, like in Germany, where any man in the nation may be selected in any city, they have professional city managers.

MR. WAITE: The same as we do here. That has already occurred. City managers have been taken from one city to another already.

Q. In connection, for instance, with the director of law, who would have the last word to say whether a case should be taken up by the city, or defended by the city?

MR. WAITE; The manager.

Q. Well, then, in the case of the financial end—I do not know what your plan is, but who is it that works out the tax rate for the next year?

MR. WAITE: Under the tax laws of Ohio, that is worked out by the budget commission.

Q. Not by the city itself?

MR. WAITE: No, in this matter there is nothing at all of home rule about taxes. That is taken care of by the state.

Q. I was wondering if there were some parts where they put such responsibility on the manager himself that really should be divided between him and the commission.

MR. WAITE: Well, the demarcation here is very, very plain. The manager is responsible for the entire administration of the government, subject, of course, to the legislative authority, the policy governing authority, the commission. Then, there is a check on finances by the charter. The commission must employ a public accountant to keep a running account, and he reports direct to the commission.

Q. There is a limitation of what you can borrow?

MR. WAITE: By law of the state, yes.

Q. In what way are you limited to bond the city for improvement?

MR. WAITE: We have several limitations in the laws of Ohio. That is, there is a limitation on the amount of bonded indebtedness on your duplicate, and there is also a limit by law as to the rate of tax. So there are limits enough.

Q. I mean, is it covered in the charter, so that you do not need to go to the legislature for a specific bonding?

MR. WAITE: We follow the state laws.

Q. If you wanted to enter into some rather new departure of government, or to construct a disposal plant or something of that kind, would you need legislation, or is that something which could be handled by your commission?

MR. WAITE: That would be handled entirely by the commission, inside of the state limitations, the bond issue limitation.

Q. You would not need any special legislation provided that issue was within your limit?

MR. WAITE: No, not at all.

Q. Can you amend your charter?

MR. WAITE: Only by a vote of the people.

Q. Of the city?

MR. WAITE: Yes, sir.

Q. You do not have to go to the legislature to amend your charter?

MR. WAITE: No, sir.

Q. The commission has no authority to issue bonds except by consent of the people, have they?

MR. WAITE: Yes.

Q. To any limit?

MR. WAITE: Well, it is rather a complex situation. There is a limit by law to the bonded indebtedness and there is an automatic

limit in the tax rate of Ohio. The rate is divided into two portions, what is known as the ten-mill limit and the five-mill limit. The ten-mill limit originally only included operating expenses of the city, county and state, and in the five-mill limit was the interest and sinking fund; but the Smith One Per Cent Law put an automatic break in the ten-mill rate. It stated that the bonds issued by the governing bodies, that is, by the county commissioners or school board, or by the city, must take the interest and sinking fund from the ten-mill. But if they put the bond issue before the people, then it came from the five-mill rate, and left the ten-mill for operating expenses.

Q. In the case of adoption of new plats of territory, who is the final authority?

MR. WAITE: The charter allows a platting commission, or allows the city to plat for three miles outside of the city. The laws in Ohio on platting are that the plats must be accepted by the city engineers. But they get around that, unfortunately, by selling their property by metes and bounds, and not by the plat. The clause in our charter enables us to get the control of the outlying territory. The owner must submit a plat, or he cannot get any improvements on that plat. You know the result, after the owners sell by metes and bounds, and the poor fellow who buys the property is the one who holds the sack. Gentlemen, I thank you very much for this opportunity.

CITIZEN CO-OPERATION IN MUNICIPAL AFFAIRS.

By J. M. Guild, Secretary of The Greater Dayton Association, Dayton, Ohio.

Mr. Chairman and Gentlemen: It is a very fine thing to find on such a program as this the subject assigned to Mr. Frederick H. Rike, President of our Association, "Citizen Co-operation in Municipal Affairs;" because in the past, as you know, there has been very little co-operation. I am sorry Mr. Rike could not be here and that he could not have been with you the other morning to extend to you an address of welcome. The same accident that prevented him from being here Tuesday morning still incapacitates him from service to-night, and so I am substituting for him.

There is so much I could say to you on the subject, for the reason that within the last few years, the American business man has turned over a most important page in the administration of local affairs. The old bugaboo that a commercial organization must not touch what they called politics in those days, that that was the rock on which they were likely to split, has been entirely disposed of. The business man is now getting into public affairs because they are his affairs, not confined to the four walls of his office as they were a few years ago, but that his business extends even into the precincts of the City Hall. It is a very gratifying thing to know that where he has tried to get into those matters, there is a welcome hand from the administrators of the city's affairs. In my work as Secretary of The Greater Dayton Association it has been part of my duties to find out how these things are going elsewhere, on account of the big experiment which was started here a couple of years ago. In the canvass I have made I find that more than one-half of the commercial organizations maintain civic affairs committees, or municipal affairs committees, and that very frequently on those committees are city officials, working hand-in-hand with the business men. It is a reciprocal proposition. By the getting together, the city official learns the views of the business man, no matter what they may be. The Lord knows he needs a suggestion once in a while. I sympathize with the man who is elected to an office, and then left there to administer it along lines for which he may not have been previously trained. On the other hand, the business

man gets his ideas straightened out by learning what the city official is up against, so that in the end it works both ways and works well.

Up to a few years ago the business man had not bothered much about the city, but the question of taxes and a few other things affecting his pocket-book brought him to his senses, and he is now getting in pretty deep. There are things here in Dayton which have been done by the business man, to which Mr. Waite (City Manager) has made brief reference. As a matter of fact, it is the business man in every community who has brought out the commission form of government. About two or more years ago, the business men of Dayton put thru three successive and successful campaigns—the first one, to change the form of government and at the same time elect a commission of fifteen men; second, to adopt the new charter prepared by these fifteen men; and third, to elect five business men as commissioners. I could talk on this indefinitely, but I am not going to, Mr. Chairman. In canvassing other towns I found only ten where they were fortunate enough to have Bureaus of Municipal Research. Dayton has been fortunate in that respect. The point in this is that it speaks well for the business men in other communities where they have accomplished so many things, without the aid of such highly trained experts as we always find in these bureaus, and it goes to show that the movement is nation-wide and gaining impetus all the time.

As probably the best example of a civic commercial body being closely associated with a city government is The Greater Dayton Association. It is a peculiar body. Is it back of the government here? It certainly is—one hundred per cent! A short time ago, certain influences started a movement here for a municipal electric light plant, a $50,000 proposition. This we were led to believe would hinder the city administration more than it would help, so we went out on the firing line and did the fighting, thereby defeating the proposition. Then over at Columbus there are, during every session of the Legislature, more taxation amendments to the square inch than can be counted.

I will attend to-morrow in Columbus, a meeting of Chambers of Commerce of the entire State. One of the principal things to be discussed there is the exemption of bonds from taxation. A few years ago, before the constitution was amended, bonds were issued on a three or four per cent basis. Now they have to add an addi-

tional one or one and one-half per cent on top of that because they made all local bonds taxable. How does this work out, and how many of the few that are held in the state are returned on the tax duplicate? Mighty few, so we have the peculiar situation of taxing our own bonds and paying an interest charge of at least one per cent without getting anything back from it—a mighty poor investment.

In other ways, the G. D. A., as it is locally called, is in constant evidence in its co-operation with the administration.

Let me read what Isaac Marcosson had to say about Dayton when he wrote it up for Collier's a few months ago: "Thoro in all things, Dayton has left nothing to chance. Even before the cheers announcing the adoption of the new charter had died down the progressive men of the town were saying: 'The success of this commission government lies in having a strong and constant public opinion behind it.' In other words, it needed a perpetual prop, and that prop came in the organization of The Greater Dayton Association. Here, then, is the force to stoke the fires of civic patriotism." I don't just like the word "prop," because our administration needs no prop, but we are constantly on the alert, and ready to respond to any call that the administration may make on us.

Elbert Hubbard had this to say when he visited Dayton: "The Greater Dayton Association creates a public sentiment which makes the work of Manager Waite effective and efficient. It works with and for Dayton's new plan of government, and is in very fact an integral part of the government. Why government should be something apart from the people, I have never been able to fathom. Dayton is nearer democracy than any other city of its size in the world—and the end is not yet- This is the work of the business men who, in order to insure successful city government above everything else, dissolved the old Chamber of Commerce, which compared with the average commercial body; and organized an association which now has nearly eight thousand members—men and women of all classes, and over six hundred women members." Mr. Hubbard further says: "Dayton stands a solid phalanx against the powers of laziness, ignorance, weakness, and the gravitation with the downward pull."

This all comes from our plunge into what was known lately in Dayton, and may still be known in other communities, as politics and the wiping out of any line between the business men and city officials. Here in Dayton we are all working together toward the goal of an ideal government. I thank you.

THE WORK OF THE FEDERATED IMPROVEMENT ASSOCIATIONS IN DAYTON.

By WILLIAM S. CRANDALL, Dayton, Ohio.

The fundamental problems of municipal government are the same in all free countries. The solution of the problems depends on the process of evolution. Necessarily, this is slow, but always sure.

Progress in municipal affairs is the result of, first, improvement in the form of government, and, second, the raising of the standard of citizenship. The form of government can be improved only by experiment, and the standard of citizenship can only be raised by developing the morality of the individual.

Prior to the enactment of the uniform municipal code in 1902, Ohio had the largest and most curious assortment of city charters of any state in the Union, ranging from the mongrel of unknown pedigree to the dignified federal system. The best at that time, when measured by results, was none too good.

While the uniform code was a step in the right direction, it was far from perfect. The next forward step was taken in 1912, when the Home Rule amendment to the constitution was enacted. This opened wide the door for every Ohio city, if it chose, to frame and enact its own charter, without regard to existing State Statutes, with the exception of the questions of taxation, sanitation, education and police powers.

Dayton was one of the first of Ohio cities to embrace the opportunity of improving its form of government by drafting its own charter. Public sentiment favoring such a change was largely created by the work of the Federated Improvement Associations, for since its organization on March 10, 1910, it had not only stood for the honest and efficient administration of city affairs, but had persistently proclaimed the necessity of a better form of government for the city. One of its members had served on the committee of fifteen, appointed by the League of Ohio Municipalities, which drafted the Home Rule amendment that was submitted to the people by the Constitutional Convention. The Federated, therefore, was well qualified to render efficient service in this movement.

The membership of the Federated consists of three delegates from each affiliated body and twelve delegates at large, the latter being selected by the organization. The personnel includes some of the best informed men from each association—engineers, doctors, lawyers, business men, one landscape gardner, and the pastor of one of the leading churches. The meetings are held twice a month, the second and fourth Fridays.

The central body usually initiates the proposals for physical betterment that are city-wide in their application. Such questions are referred to the local bodies for their consideration, and adoption or rejection. When approved by two-thirds of the associations, united action is assured.

Frequently the Federated is asked to assist in securing an improvement within the bounds of a local organization, for the purpose of obtaining quicker and more favorable results, which is generally successful. This method of operation is carried on with the city in a co-operative rather than a critical spirit, and, thus far, has served to increase the influence of and confidence in the organization.

Naturally, the material improvements occupy most of the time and attention of the various associations as well as the Federated. Concrete betterment appeals more strongly to the mass than the abstract questions that come up for consideration, because it is something that can be seen, and its benefits are more apparent to the rank and file. In this form of civic duty the Federated has not only been loyal and faithful to the best interests of the community, but efficient in its service.

In the campaign for a new charter, the leaders of the Federated and a large majority of the members of the affiliated associations were found among the foremost who demanded the election of a charter commission to draft a new form of government.

A citizens committee of one hundred, afterward increased to one hundred and fifty, was selected by the business interests of the city, to determine what particular form of government should be chosen. The relative merits of the commission form and the commission manager plan were carefully considered, the latter receiving the majority vote. This fact is mentioned only for the purpose of showing the loyalty of the Federated to the common weal, for notwithstanding the fact that most of its members favored the commission form, it earnestly and whole-heartedly joined the majority in the effort to secure the commissioner manager plan.

And then came the flood. And after the flood the charter commission was elected by a large majority over the partisan opposition. It is worthy to note, also, that the vote polled was larger, in proportion to the total registered vote, than that of any other Ohio City; voting on a similar question.

For nearly two years the commission manager plan of government has been in operation in Dayton. At no time has the Federated had any reason to regret its share in the work of securing the new form of government. On the contrary, while some mistakes have been made, which was inevitable, the efficiency of the new administration has been all that could be desired. And what is equally gratifying to the Federated, the new administration has co-operated with it in all its efforts for promoting the general welfare of the city. Moreover, the administration has appreciated and seemed to welcome the suggestions and assistance of this organization. The attitude on the part of this administration has been radically different from that of previous administrations, under partisan rule, and, therefore, is a cogent reason why the Federated is the more inclined to defend the new form of government.

While the Federated has been faithful in promoting material improvements and in bettering the form of city government, it has not neglected its duty in helping to raise the standard of citizenship. Besides, all of the affiliated associations have been diligent in their efforts along the same lines.

The associations have endeavored to make better citizens out of their members by disseminating civic information, by cultivating their tolerance and self-control, and developing their conscience and sense of civic responsibility. For example, one method used by one association was to invite the head of some department or bureau, from the city manager down, to address the members at their semi-monthly meetings. In this way the rank and file of the members have the opportunity of securing information as to the administration of affairs in every branch of the city government. Besides, it offers an excellent opportunity for the members to get acquainted with the city officials. Similar methods have been used by most of the local associations. The results cannot fail to be beneficial to all concerned.

While claiming credit for its own work, the Federated does not ignore nor seek to minimize the splendid work of the Greater Day-

ton Association and the Citizens Committee, along similar lines among the business men of the city. These organizations are here to speak for themselves.

Although the new form of government has been thoroughly established, it does not follow that the work of the Federated and other groups of interested citizens is finished. There will always be something worth while to fight for. And above all things, it must not be forgotten, that there is no form of government, however perfect it may be, that can assure, in itself, a clean and efficient administration of city affairs. Something more is needed and that is, the maintenance of a quickened citizenship and a higher standard of citizenship. If to the better form of city government this be not added, then there is the possibility—nay the probability—that the reform forces may or will become as much of a menace to the community as old line partisan rule. Hence, it behooves the leaders in similar work everywhere to watch out for breakers ahead. In this connection I wish to quote the words of James Bryce, late Ambassador from Great Britain to the United States, taken from his Yale lectures on the responsibilities of citizenship. Under the caption, "Results of a low standard in the leading class," he said:

"Those men whose wealth or education, or connection with public affairs makes them prominent, constitute what may be called the Tone Setting class, by which I mean the class which, from its social authority as well as its intelligence and power, forms the standard not only for those who conduct public business, but also to a great extent for the whole community. Such a class ought to set a high standard. When it, or any considerable part of it, sets a low standard and admits or tolerates in public life motives and methods which would be condemned in private life, it depraves the morality of the community, and thus the stream is poisoned at its source and politics are defiled and debased, selfishness and trickery are taken to be natural, and public life becomes the favorite hunting ground of unscrupulous or reckless men."

OBLIGATION OF THE STATE TO THE MUNICIPALITY IN MATTERS OF PUBLIC WORKS

By Alexander Potter, Consulting Engineer, New York,

It is perhaps universally conceded that the state fundamentally should properly have certain advisory rights over the acts of municipalities on matters of public works and utilities.

But while it is conceded that certain advisory rights are proper to a state, laws have been enacted in many states giving state commissions more than advisory rights. They have been given supervisory powers and oftentimes rights of drastic regulation over the aflairs of cities, which, unfortunately, have been wielded to a degree far in excess of what is actually needed for the general good either of the state or of the component parts of that state.

It is the purpose of this paper to show that this ever-growing tendency to increase the powers of state commissions to interfere with the affairs of municipalities in matters of public works and utilities is a mistaken one, and that these powers should be curtailed and limited to advisory rights alone.

The conditions which have brought into being these various state commissions involve many important and various questions. For instance, that which might seem of greatest benefit to some particular municipality might be inadvisable if applied generally to other municipalities of the state or to the state as a whole. The particularly interested municipality is perhaps incapable of seeing this, having only its own interests at heart, and hence some central state right of inquiry is needed for the general good.

Serious questions are constantly arising between municipalities and privately owned public utilities companies. Agitation for a municipal water supply has often been based upon the assumption that existing water mains of private companies have been in service so long that the piping system is worthless. Where such an opinion has been based upon mistaken ideas it was highly proper that some central body should have the power to intervene to prevent the destruction of values. Hence the necessity of creating state utilities commissions.

Public service and utilities commissions also have come into being because corporations that have grown rich and arrogant by reason of long abuse of franchise privileges have oppressed consumers, and it has become necessary to reduce their rates to figures which represent only a fair return upon their investments. The ordinary provisions of law are oftentimes too cumbersome to promptly effect this adjustment, and it has been found to be much speedier of attainment thru these commissions. But while created to regulate the public service companies, they are sometimes made, unwittingly perhaps, the vehicle for the improper protection of such companies; as for example:

The speaker was recently retained by a city to consider and report upon the purchase of a plant owned by a water company whose rates were excessive, or to formulate a demand for an adequate reduction in rates. After reading the speaker's report justifying municipal ownership, in order to prevent action thereon the company agreed voluntarily to reduce its rates 20%. This proposition led to the abandonment, for the time being, of the municipal ownership campaign. When requested to execute a contract giving this reduction in rates, the principals of the water company advised us that the law prevented any such agreement except after hearing by the State Utilities Board, and that the reduction granted would depend upon the effect that the establishment of such rates might have upon the rates charged in other municipalities where conditions differ widely from the conditions existing in the place under discussion. Here was the "nigger in the wood pile." The powers granted by law to the State Utilities Board are so drastic and far-reaching that they have actually overshot the mark and are reacting against the municipalities of the state in a most unfair way. Here we have a city where the water company has been forced to admit that their rates are excessive and that they can afford voluntarily to reduce them, but they are not permitted to do so if the rates so fixed are not consistent with rates in other municipalities not now under consideration, and where conditions of service may be widely dissimilar.

Concerning clothing with power such organizations as state boards of health and water supply commissions over the acts of municipalities in public works matters: cities that would build large reservoirs by the construction of dams where failure might involve large loss of life within or without the municipality, should have their plans

reviewed and subject to revision by competent state authority to safe-guard stability. Cities that would grossly pollute the streams of the state should be prevented from doing so by competent state authority in cases where the volume of flow cannot properly absorb the sewage flow. Cities that would wish to construct improperly devised sewerage systems should also have their acts reviewed by competent state authority. These things are proper and necessary for the general protection, but it must be remembered that assumption of arbitrary powers on the part of the state carries with it grave responsibilities not to interfere with the individual rights of the municipalities themselves to their hurt, nor to force upon municipalities unnecessary burdens of taxation. But it is just such encroachments that have many times come under the observation of the speaker and which would be made rarer by a curtailment of the powers granted to these commissions.

The appointees to the state commissions are usually subject to great political influence, and oftentimes this influence is more potent in directing the actions of state commissions to the benefit of private interests than to the best interest of any particular municipality, and is wielded to the detriment of the municipality. It cannot be gainsaid that during the past decade the arbitrary use of power by various state boards, exercised without much thought, has seriously interfered with much-needed public improvements, while forcing upon other municipalities vast unnecessary expense for which the municipality itself received no adequate benefit. Worse than this, because of the vast power of these commissions, engineers themselves are oftentimes, unfortunately, placed in the position of aiding and abetting unnecessary expenditures by their clients or else involving themselves in a perpetual fight with a strong and influential body, only perhaps in the end to be worsted and practically driven from business in that particular state where they have dared to oppose the will and the power of stronger influences.

A prominent engineer once told the speaker that the requirements of the State Board of Health in the state in which most of his practice obtained, were costing his clients from 25% to 33% more than his sound professional judgment considered necessary, and that he permitted this, he said, simply because he found it necessary to keep on good terms with the state authorities in order to have his plans promptly approved.

That supervisory powers have been exercised in an arbitrary manner to the detriment not only of the municipality but the state as well, is perhaps best illustrated by reciting the practice in a prominent state. The slogan of the head of the State Health Department has been, "Restore the streams to their natural purity."—an attractive and pleasing cry if one disregard the cost and take no thought of what it entails upon the people and industries of the country. This slogan has made it mandatory for this official and his state engineers to demand refinements in sewage purification and disposal for cities thruout the state to an extent that was wholly unnecessary in many instances and so expensive that cities have refused to take even the first step towards the construction of such plants. It gives me pleasure to record the growing tendency of late to reason with these cities instead of coercing them, and when this spirit is established it will be comparatively easy to secure their co-operation in the construction of rational sewage treatment which will remove from such cities and their neighbors any cause of complaint of pollution which might constitute either a menace to health or a nuisance *per se*.

In another state, the Commissioner of Health, out of a superabundance of misguided zeal, caused the defeat of a much needed water supply because he insisted that the discharge of even *purified* sewage of another town of 6,000 or 8,000 people, fifty miles above the point of intake, rendered the proposed water supply unfit, notwithstanding that it was proposed to build an impounding reservoir to hold a year's supply and to filter, soften and sterilize the water from this impounding reservoir; and as a result of this opposition, the city retains its old polluted and inadequate supply to this day.

Another example of official interference which came under the observation of the speaker was the case wherein the executive official of the health department worked hard to develop a method of sewage disposal.

Another outcome of this excess of power has been shown where a state official gave permission to construct and, because he thought the conditions warranted it, even forced the town to action, only to withdraw such permission later at the behest of strong political influence even after construction had been started, altho his heart was not in his act.

The instances cited have come within the personal experience of the speaker. A score of others, alike and radically different in character, could be added by nearly every engineer who has come in close contact with such bodies.

The phenomenal success of this country as a nation is due in no small measure to the fact that the states are allowed a free rein to enact their own laws and to be practically independent factors in matters affecting the welfare of the state. If this is true of the relation between the nation and the state, should it not be equally true when applied to the relation between the state and the city? Should the state exercise authority and rights over the city in matters which the city itself is amply able to take care of? Should the state solve problems for the city which the city is ample able to solve for itself, acting either alone or conjointly with a number of other cities?

As an example, let us consider the condition existing in New York City by reason of a law granting the state supervisory powers over the public utilities of the city. In 1907, by the advice of the then Governor, now Justice Hughes, a Public Service Commission was created—a state organization—to be composed of men so high-minded and above suspicion and reproach that public service utilities, the subways, the gas companies, the electric companies of the great city of New York, should be free from the domination of Tammany Hall. Now, in this brief interval what condition has been brought about? The people of this city have repudiated Tammany Hall and have put into office high-minded men who have been endeavoring, against great odds, to give the city an honest and efficient administration. Yet, in the expenditure of $300,000,000 of the money of the people of the city of New York, the city officials have no voice. The five Public Service Commissioners are entrusted with the expenditure of this vast sum. Of this body, four are out-and-out Tammany men, and the fifth, the personal counsel of a Republican governor, whose only bid for fame was his investigation into the alleged inefficiency of this self-same Public Service Commission. This investigation resulted only in the removal from the commission of the only independent and fearless expert then upon the commission, Dr. Milo R. Maltbie, an expert of great and proven efficiency, who was replaced by the investigator himself, a man without experience in these large affairs.

If the state enacts laws which turn over to its appointees the control of certain branches of the city governments, why do they not assume all functions of the city government? Such a course would at least have the virtue of consistency to commend it.

Further extensions of the powers of state commissions must inevitably lead to a weakening of the constituent members of the state family, viz.: the municipalities.

We must not lose sight of the fact that the creation of public service and other commissions during the past decade has served, and is serving, a good end in standardizing practices and in indirectly and directly molding public opinion along rational lines. It is now a rare occasion when any city, large or small, will think of undertaking the construction of any public utility, such as water works, sewerage, electric lighting system, etc., without proper technical advice.

Long before the establishment of boards of health and state water supply commissions, many cities had these utilities properly designed and constructed under expert advice. The creation of boards of health, water supply commissions, and similar commissions has, however, rendered great public service in that they have forced the realization that this should be the rule for *all* cities and towns.

Hereafter, the function of such state commissions as herein referred to should be to occupy more of an advisory position and exercise less of a supervisory and dictatorial power over the actions of cities than has been the case in the past. The acceptance of this suggestion would tend to the unification and consolidation of these state commissions, to the great saving of the state. With state control, the tendency to establish some set formula which is made applicable to all cities is too great, whereas, as a matter of fact, there are no two cities where the conditions require identical treatment.

To bring about the changes suggested in this discussion in the laws already enacted or to prevent the enacting of similar laws in other states, will require both time and perseverance on the part of the engineers of this country in the education of those in state authority, who, by law, are supposed to be their mentors. In matters of sanitation we must also educate the medical profession, whose sense of proportion is grossly out of focus, otherwise they would long ago have realized that the line of least resistance would have

been to see that measures were taken for the prevention of the twenty preventable deaths from tuberculosis, for instance, which is purely within their province, instead of demanding absurd standards of sewage purification; sewage purification, at best, sharing only in a very small way in the honor of preventing the one death due to typhoid at a cost many times that of preventing one death from tuberculosis.

It is said that the meek shall inherit the earth, but the engineer who meekly submits to, instead of effectively protesting against, practices that he knows to be wrong, even when sanctioned by law, cannot claim to be doing his best.

DISCUSSION.

MR. SHERRERD: While the speaker concurs in many of the conclusions reached in this paper, it presents a radical view of the situation; it rather strikes a note which is a little beyond the mark. There are certainly functions of state boards which, properly exercised, result in much good being brought about, thru a concerted action for the development of municipal utilities for the joint good of adjoining municipalities thru the agencies of state commissions, which cannot be as well done thru the efforts of the local government. Take, for instance, the installation of water supply systems for the joint benefit of adjoining municipalities, where at least the smaller municipalities within the district which are supplied could scarcely of their own initiative secure the advantage which will result from the participation in a joint project. In other words, in small municipalities, having from five to twenty-five thousand population, where they are anxious to get gravity supplies of water which need to be brought from a considerable distance, they cannot as economically install separate units for their supplies, as can be done in the metropolitan district around Boston, where the smaller municipalities are furnished water at wholesale, and such is the proper function of state commissions. And on the question of providing adequate sewer facilities, it may be a proper function of state commissions to combine in one general project the proper provision for the taking care of the sewage of such a dense population as resides in the metropolitan district surrounding Newark, New Jersey, where it was necessary to get the combined action of some twenty or more municipalities, to arrive at anything like a satisfactory result. What would

be the situation if each one of those municipalities were forced to provide for sewage disposal within its own closely built up borders? That matter is one of very serious importance in such situations, and one which in New Jersey has stirred up a tremendous amount of animosity between the smaller municipalities who propose to put in sewage disposal plants within the boundaries of adjoining municipalities, whereas the state commission, or the commission which has charge of the entire district, proposes to install, and is now constructing, at an expense of some $12,000,000, a trunk sewer which will be adequate for the entire territory. So, while there are, no doubt, as the writer has pointed out, some situations wherein state control by commission works to the detriment of the individual municipality, to condemn the whole system as far as is done in this paper, is a mistake, because there are compensating advantages that may be obtained from a proper administration of these larger functions by state control. The expression in the paper, that provision for a greater share of home rule for our municipalities should be adopted by legislation seems wise. It is unfortunate that municipalities must, under most of our state governments, apply to the legislature for one law to do one thing, like the construction of a garbage disposal plant, and for another act to provide funds for water supply purposes, and in each instance is likely to get an act which would not be applicable to another city. For each city to be obliged to depend on legislation enacted by a legislature in which it does not have equitable representation is a serious question in that it makes one municipality dependent on the whim of another. In other words, while in our federal government the smaller states are represented in the upper house by the same number of representatives as the larger ones, it is questionable whether such form of government should apply to the states, for the reason that the autonomy of the states is on a very much different basis in relation to the federal government than is the situation of the municipalities or counties in regard to the state government. That is, the municipality and county are creatures of the state, and one of the very serious problems which has confronted municipal officers, in New Jersey at least, is the fact that it is found that laws which give to public utility companies the right to make contracts and recognizing any grants given to a company as a vested right for it, do not make concessions granted to the municipality a vested right for the municipality, and that an act of the legislature may in one fell swoop upset a contract

which a municipality has made in good faith. Such a situation is one which might create serious difficulties, and is one which has caused much concern and necessitates incessant watching of legislation that affects municipalities. Some adequate remedy should be found for such a situation.

MR. POTTER: No instance cited by Mr. Sherrerd actually required the creation of a State Commission. If the construction of a new water supply is too large an undertaking for one unit of a group of adjoining cities and towns, then two, three, or a dozen such cities can easily combine their efforts in a common project. The laws of many states already provide for such co-operation.

The American Constitution breathes a spirit of individual development. The development and responsibility of the individual citizen makes for a better municipality, and in like manner the development and responsibility of the individual municipality makes for a better state. To permit the state to supply all of our wants is paternalism —the suppression of the individual.

It might seem that the state once clothed with proper power can more readily compel compliance with its will in the way of supplying needed public improvements even if it robs the individual or the municipality of its right to personal action, but the experience of the past is such that even this may well be doubted.

The special case in New Jersey cited by Mr. Sherrerd bears abundant witness to the truth of this. In 1897 a State Commission was appointed in connection with the Passaic Valley Sewer, which is the project to procure a common outlet for the sewerage of the cities between and including Newark and Paterson. The cities of Passaic, Orange, Montclair, East Orange, Bloomfield, and other cities in the Passaic Valley, were planned to be served by this sewer.

In 1898 the representatives of cities and towns in the valleys of the Rahway and Elizabeth Rivers in New Jersey met and organized the Joint Meeting to build a sewer to tide water. This project sewers a part of the cities of Newark and Elizabeth as well as the municipalities of Summit, Millburn, South Orange, Irvington, West Orange and other municipalities in this territory. At that time there was no statute permitting such a combination and the project was delayed several years in order that proper legislative action

could be secured to make the construction of this joint sewer possible. Notwithstanding these delays, the joint sewer was completed and put in full operation early in 1904 without litigation or serious trouble of any kind. The Passaic Valley Sewer under state control may possibly be completed in 1916 or 1917. It was brought to the construction stage only by the adoption of the basic principle of agreement suggested by the writer and adopted in connection with the joint scheme above referred to, the principal feature of which was voluntary co-operation on behalf of each and every municipality benefited and the securing of their approval to a proper method of apportionment of cost. The only feature of the joint trunk sewer scheme not followed in the Passaic Valley scheme was that of the apportionment of cost, and the scheme of payment actually followed in the Passaic Valley Sewer came well-nigh wrecking the whole project, and at this date the important cities of Montclair, East Orange and Orange are not participants in its construction.

If cities acting conjointly can put in operation a scheme of public improvements twelve years ahead of a similar scheme preliminaries for which were actually started first but under the control of a State Commission, Mr. Sherrerd's allusion to this as an argument for a State Commission is, to say the least, unfortunate. The "tremendous amount of animosity" between the smaller municipalities referred to by Mr. Sherrerd as having developed among certain of these Passaic Valley towns was, as a matter of fact, produced by the existence of the State Commission. Nor does this same State Commission have the power to stop the "small municipalities who propose to put in small disposal plants within the boundaries of adjoining municipalities" even when they propose to place such disposal plants within the boundaries of those cities who are building this Passaic Valley Sewer under the direction of the State Commission referred to by Mr. Sherrerd.

It is difficult to conceive of any set of conditions wherein joint action by the municipalities themselves cannot be as productive of good results as by State Commissions.

THE CITY AT WORK.

By LOUIS L. TRIBUS, Consulting Engineer.

FOREWORD.

To plan a city or readjust in intelligently and operate it efficiently so as to meet the requirements of modern days may be likened to the growth of a tree.

Its roots must be several generations of cultivated brains, drawing from a soil of sympathetic and well intentioned people. Its trunk must be the concentrated purses of the community, strong and sturdy if the branches and twigs are to be vigorous.

The branches are the decentralized, largely self-contained chief functions. The greater the city the more diversified and the stronger individually will be the branches.

The twigs may be likened to the bureaus or specialized activities, while the leaves are the workers drawing subsistence and backing, in part from the roots, but largely from the atmospheric gases and moisture, the suggestions from the wider world. Encourage the leaves to best efforts and the trunk itself will gain strength—dip them in standardization varnish, eliminate individuality, and listlessness follows with ultimate slow death of the whole tree.

He who heeds the lessons of nature will find them the best pattern for works of men, but intelligence of high order must be exhibited in selecting the proper ones to follow.

Members of such organizations as the American Society of Municipal Improvements should be of those competent to heed as they run and put to effective use the information gathered.

BROAD ASPECTS.

In the beginning of the present generation's attempt to develop cities for the comfort and convenience of its inhabitants, much was written of "The City Beautiful" and many an attractive picture was drawn of Civic Centers, with artistic buildings, manicured shade trees and dainty nursemaids and their charges parading in well kept parkways.

The next stage of thought has been classed as the "City Economic," dealing with accessibility, transportation and development of workers as producing machines.

In process of passing are the throes of the "City Efficient," where labor is directed into channels of classification, standardization and the most laudable attempt to secure one hundred cents of value for each dollar expended.

To large degree the latest "fad" is inclusive of the earlier ones; the "City Plan," productive of conventions, conferences, committees and convulsions.

City planning, in all but the humanitarian side, has been practically co-existent with the gathering of men into cities.

The African, in his kraal, showed some regard for arrangement to suit his primitive requirements; the early Egyptian carried the art to a high degree of effectiveness; the Cretan, the Assyrian, the Roman preeminently, the East Indian, all developed certain phases of the subject.

But in the pre-Christian era and among races not imbued with man's responsibility to and for man, the "Beautiful" and the "Economic" only, received attention, while efficiency and humanity, only controlled as they met the whim of the ruling classes.

As understood by the broadest-minded students, city planning calls for the best combined efforts of engineers, architects, sociologists, philanthropists and hardheaded business men. To produce efficient and harmonious results they must work together and when thus working, even the purely political official will fall in line and support such plans as may be promulgated.

To enumerate all the essentials of a proper city plan, would require a volume equivalent to a young dictionary, and to become a real expert in city planning requires several lifetimes of study and practice, but certain main or typical points can be set forth.

Unfortunately, opportunity to plan a city rarely comes, until it is actually so built as to be almost hopeless of redemption from the faults due to ignorance, cupidity, false economy and what is almost a crime, gross carelessness.

As a class, city officials are not trained in the vital principles of even good government, much less intelligent planning and effective execution. Many city engineers are called to service from the ranks of the unprepared, because of personal pleasing qualities, or often simply political pull, consequently it is a matter of gratification that no worse things are planned.

The writer does not desire to be pessimistic, but the "Should not have beens" are as yet much more obtrusive than the really good things done.

The present movement, if not shelved as a passing fad, will do much to undo the past, more to prevent further uneconomic atrocities and most to create new conditions of beauty, comfort and efficiency. May engineers prepare and stand for the best thought and most effective execution.

The problems of a great city differ widely from those of a small community though including the lesser; particularly feeling the pressure of meeting current needs of rapidly growing populations.

If all but the improvers could only go to sleep for ten years, what wonders could be accomplished, granted united, intelligent development ideas.

What are some of the objects to be cared for? Good streets, water supply, sewers, parks, etc.? Yes, and far more.

The unit of society is the family, not the individual, though politicians and many sociologists do not recognize that fact, a city is but an aggregation of housed families at work.

The family needs work and rest, its members must have education, physical, mental and spiritual; they should have easy and quick access to their places of labor and of recreation; they require the best of wholesome food and household supplies delivered at their homes at the lowest prices and with the least effort; they need the removal of waste products, with the greatest expedition at the least cost consistent with sanitary perfection.

Securing such results would bring the ideal of community physical conditions.

Social Necessities.

Beginning with the Child. Wanted: intelligent parentage, a clean home with abundant fresh air, pure water, safe milk, wholesome food, love; nearby well equipped school; reasonable play ground space off the streets, open and covered, suitably supervised though not bossed; manual training and general broad preparatory education, up to the point of being able to work for either higher special attainments, or for an immediate living.

Next the Near-grown. Wanted: facilities for higher education, not free, but to be worked for; clean social amusement and recreation, art galleries, museums, libraries, parks, good music, church activities; office, store, shop and factory conditions making for efficient work with suitable pay and helpful encouragement.

Finally, the Adult. Wanted: primarily, suitable work surroundings, but also features that go to relieve the strain and satisfy wholesome longings for rest, recreation and cultivation of the esthetic and religious sides of life.

Local Conditions to Recognize.

Before any plan can be considered, certain conditions must be set forth and a scheme of probable growth outlined.

Is the community small and likely to remain a small town or city? Is it manufacturing or residential, seaport or inland? Will it be a medium-sized large city or a large, small one? Is it already a great city with all kinds of interests and cosmopolitan population? If existing, can it afford radical reconstruction to produce the best final results or will a scanty purse seriously handicap development? It seems fairly evident therefore, that the individual case must be in mind in order to even establish general principles to be set forth and followed.

It is a popular and useful study for students to assume a given area with specified topographical and geographical conditions and sufficient population with a variety of interest, and try to plan the town, but an academic study solely, of little practical value.

Transportation problems constitute a special field of expert activity; their solution depending not so much on the city plan itself, as on the wisest use of the accomplished plan. Whim and

sometimes some casual circumstance usually fix the objective centers, rather than any prearranged idea, consequently, the plan can do little for transportation other than provide for streets of adequate width and enough thoroughfares in every direction to meet possibilities as well as probabilities.

In modern municipal planning schemes, the poor are likely to be well considered; there being little scarcity of social uplifters and the poor yield many votes; the rich can and do take care of themselves, but the great middle class (considered in point of purse) is really the one to be most carefully looked after, yet the one most neglected, albeit the real tax supporters of our cities and the source of their greatest wealth.

To meet its need, less of community assistance is required, but more of the larger parks, museums, libraries, concert halls, places of amusement, churches and institutions for higher education, not free, but easily accessible, combined with speedy transportation to the residential districts.

The rich will also make some use of such facilities, but to limited degree in comparison.

Water front conditions present peculiar problems, factory and shipping, with distribution and collection of products and cargoes.

Granted that the spiritual, intellectual, recreational, work and housing needs can be adequately provided, at public and private expense, and that transportation to and from work and plan can be conducted with the least loss of time and friction and at reasonable expense, we then find looming up a tremendous subject, the gathering and distribution of food and fuel; the reception of raw products and shipment of finished manufactures, for both home and foreign use, and the removal and final disposition of household, store and factory wastes.

The wastes run into thousands of tons daily, yet a large proportion have continuing value if separated and delivered at suitable utilization points; of the ashes alone nearly 25 per cent is serviceable fuel, after screening and washing, well worth recovering.

Lost table silverware, impossible of identification, abandoned household articles, rags, bottles, scraps of metal, some classes of paper, etc., make an astonishing total in value; most of the mater-

ial worthless to the original user, but when gathered and classified is well worth looking after.

Garbage, with proper treatment in sufficient quantities, possesses elements of value that can make a very helpful offset to the expense of collection and handling.

With a city, as with the conversion of raw materials into finished articles of prime value, the by-products and apparent wastes will be neglected when those in charge are willing to remain inefficient and extravagant.

New York as an Example.

As the larger includes the less, New York may be taken as typical; in need of original development, correction of gross errors in plan, changes to meet unforeseen conditions, with much commensurate with its importance and wealth that would be out of place and beyond the purse of a lesser city.

Its growth for the past and present generation has been so rapid that to try and keep pace with even the vital needs has been a colossal problem.

How to house the population and provide transportation to and from places of work, has been the most conspicuous need. A history of that public necessity alone would be subject matter for volumes.

Possessing one great financial and legal center which draws its daily quota of active thousands, in large measure well paid late arrivers and early goers, whose homes consequently may quite readily be at a distance to meet individual convenience, their transportation adds but little to the congestion of traffic.

General business is less concentrated, but at the ferries and bridges reaching Manhattan, the humbler workers and sales folks make huge congested throngs, difficult to handle and a problem to disperse; fortunately for convenience, but unsatisfactory as a traffic problem, chiefly moving in the same directions during the so-called commission hours of 7 to 8:30 A. M. and 5 to 6:30 P. M.

New York though not usually so understood, is one of the greatest general manufacturing cities of the world; to meet demand for cheap products its workers are somewhat low paid, so must find homes or at least abiding places, within walking distances if possible, or short time cheap travel.

Practical necessity therefore controls, rather than real comfort and humanity.

To meet not only the needs, but the proper wants of these countless thousands of factory and home workers requires the highest phases of philanthropic and humane city management, remembering that from the children in this land of undoubted opportunity will come the wealth of the early future; wealth earned, even if not fully shared.

Take the New York problem of sewage disposal—no other large city possesses equal advantages for water disposition, yet by an abuse of its privileges and the neglect of the educational side, by not only New York in all its divisions, but the neighboring cities of New Jersey and those along the Hudson, the harbor waters have become foul and in places have already reached a stage of nuisance. The city plan must solve that problem and the allied one of refuse and garbage collection and disposition, but will first have to educate a generation of citizens, before willingness will be shown to meet essential expense.

LOST MOTION.

An important underlying principle in city planning, has been but recently recognized, viz.: the prevention of lost motion, ineffective effort, wasted products, unnecessary wear and tear, excessive noise, short-sighted development requiring early replacement, etc. These items actually concern every line of community existence, but are very elusive in treatment and often the broadest-gauged clear-visioned workers are derided as extravagant and ahead of the times when they suggest intelligent, comprehensive schemes at the cost of some dollars. That first cost is apt to be a controlling factor, even in face of acknowledged greater continuing economy reached through larger first expenditures.

This is necessarily so not infrequently, for private purses and many cities can not always stand present large payments.

OVERDOING BUILDING.

Some time it will be recognized that many, even of the moderately well-to-do, have no economic right to own city property, because the expense of meeting proper developments for general comfort and public betterment is beyond them without undue strain and

burden. This seems a rather hard-hearted view, but ownership as against rental is not much cheaper in the long run, though there is a certain mental tonic and uplift in the pride of possession.

Just so long as the property owner is content with a home of average value and moderate size, so that maintenance expense is reasonable, then ownership may represent economy, but only, however, when annual taxes, repairs, insurance and assessments for benefit, plus a sales value probably less than original purchase or construction price, is less than an equivalent rent for the years of occupancy. The well-to-do are rarely content with the more moderate facilities, so that when change comes, serious loss ensues, or hardship is entailed upon heirs, often more than balancing the comforts of greater luxury and convenience for the period of use.

This is more, perhaps, of an individual economic problem than a community affair, yet it has a bearing on the locality, for the welfare of each neighborhood is indissolubly tied up with the welfare of each family.

To ensure the greatest output of a commodity, specializing the machine and the worker, reduces the cost of manufacture and increases temporarily the stockholder's advantage, just as does intensive farming produce the greatest crops, but in such course the human worker is degraded, and the soil impoverished, unless in the one instance the manager possesses unusual intelligence, Christian principle and thought for the successive generations of workers, and in the other, the soil is replenished with suitable elements.

Scope of Management.

There are three great phases of Municipal Management: Health, Police and Development; but each one so completely dovetails into the other as to make logical separate analysis almost impossible.

To conserve public health requires the exercise of police power, construction and maintenance of utilities. To adequately police a city in the broad sense, demands promulgation of health rules and execution of public works. To design and maintain public works, the basic principles of health protection and the guaranteeing of police facilities must also be considered.

Differentiating, therefore, can only be a measure of expediency and arbitrary division. The larger the city the more complicated

will be its functions and the more extensive in kind, because of the greater capacity to spend, that usually accompanies big populations, i. e., in so-called civilized lands. To care for these functions involves the employment of many hands and feet and to successfully conduct them, the best action of many brains.

METHOD OF ACTIVITY.

To produce the best from any human being there must be given to him the largest measure of responsibility that is compatible with his capacity and the scope of the work; there must be held out the prizes of personal commendation and recognition for accomplishment, and sure advancement in position and remuneration, if fitness justifies.

There should be permanence of employment, if possible, and a living wage as the absolute minimum.

What have these things to do with a city's own work? Everything, for from the trained men (and women) employed according to righteous principles, will come many good ideas for making changes. This does not decry the occasional retention of outside specialists, who can bring fresh ideas and perchance a broader vision, but their assimilation and execution will be most intelligently handled by the regular staffs.

From time to time, from the ranks of such trained workers, there will go out to wider fields some particularly able character, who will study the problems of many places and be able later to offer perchance the brilliant suggestions that students closer at hand may overlook.

To accomplish the best ends, there must prevail absolute centralized final control—but equally important, decentralized responsible execution.

A policy, years in advance, must be outlined; expenditures must be anticipated and authorized, according, to, 1st, absolute necessity; 2nd, reasonable desirability, and 3rd, esthetic taste; each just so far as the public purse may warrant and private purses be able to follow.

According to size of city the central authority may be one man or a group of men, preferably, however, not less than three or more

than nine. Some think there lies wisdom in large numbers, but there also lies evaded responsibility.

The central source would delegate all power of execution, without intermediary boards or committees; the central managers should be entirely freed from administrative responsibilities and acting as heads of departments, though wisely they may have oversight (without detail authority) of functions suited to their individual qualifications.

Under general laws and controlling rules each division of actual work should have its own manager, or several if necessary, but he should be supreme in the expenditure of authorized funds for approved activities. Duly hedged about by these rules, employment should be free within limits suited to its character and appropriate title of workers; the remuneration of individuals should be subject within limits to the immediate superior officer, who in turn comes under similar encouragement and restriction.

In such aggregations of men as in the Police and Fire Departments of a great city, more uniformity of wage is necessary, still, individual merit will soon stand out, aside from special opportunity, and can be recognized, but in no city will the best work be secured, where class or title of position finally determines individual pay; and where others than immediately responsible superiors can veto promotion or demotion and increase or decrease the financial recognition.

Such a system of management is positively heretical in the eyes of the political city official, or the hide-bound civil service protectionist. But if officials are to be held responsible for results, not alone at the polls, but as stewards of the people's money and interests, such methods must prevail. Where such policies have been well tried, unit costs of work, all expenses included, have come down and unit wages have gone up.

Success is the greatest stimulant to increased effort, hence the method of governing that treats workers as men and not machines is the most powerful factor in securing best results in plant and operation.

In the days of three and four-story structures fuel delivery and ash removal entailed no difficulty, except at times of great snow storms, but in the coming of the great office and store buildings

and apartment houses, with their huge heating and power plants, difficulties follow fast, for quantities to be handled reach large tonnage each day; food for these houses and large hotels must be delivered on time daily and the waste must be removed with equal expedition.

The city scheme of work must consider not only proper provisions for the receipt, transportation and delivery of such fuel and supplies, and removal of the by-products and to some extent the recovery of their remaining value; but management and legislation also are important in the solution.

The management of a city is no mean task, yet until very recent years a glib-talker, with desire for public honors, some thickness of hide, not always too high ideals of integrity, and well endowed with the element of leadership, could secure official position. Sometimes a remarkable development for good came with the responsibility, but too often, alas the only good came to the particular wigwam of Indians in the case.

Today conditions have changed; employment of a qualified "City manager" is the order of events; the job hunter, the ward heeler, the political sycophant, keep in the background, but let us not suppose their breeds are dead; just a little shy at present.

The condition of affairs means that the public recognizes, partially at least, that the running of a city is a business matter and a complex one at that, changing in some phases every year.

Each of the three great functions requires not alone rules for guidance, but laws for control. Laws are of two classes, permissive and restrictive. A city needs both; the former to enable the chosen public servants to do certain things with sanction of explicit public authority, the latter to prevent individuals or classes infringing the rights of others.

Laws emanate from the people governed, so to secure best working conditions in the broadest sense, the nearer those governed can change them as need develops, the better for their welfare. Outside of general laws to control the relationship of cities to the surrounding country and other cities, the fullest latitude should be given to the individual community to govern itself and develop itself.

The general similarity of mankind and effect of mutual contact with selfish purse restrictions will be guard enough in most cases,

and placing direct responsibility upon local officials will save many a bad scheme being carried out under the practical evasion and excuse, "mandatory legislation."

With local law makers and a few elected executive officials to centralize responsibility, there can be decentralized authority in execution, with resulting maximum of efficiency.

There are necessarily many inequalities in the bearing of city laws, the basic principle of which may represent justice, but their operation may sometimes work great hardships.

Street Mapping.

It becomes essential in the planning of a city to try and anticipate the future, so that when the rush comes, all will be ready for it, yet not infrequently adopted street plans, even carefully thought out, do not meet to best advantage the type of development that actually demands attention.

It is scarcely practicable in the more open portions of a city, waiting for a population, to actually lay out, open and improve the streets, for the cost becomes more than abutting properties could rightly bear, and development instead of being encouraged, would be virtually handicapped.

Under the usual form of law which permits property owners to do what they choose with their own holdings, provided nuisance is not created, any provision for definite street layouts becomes injustice, unless accompanied by some kind of compensation. A "paper" street, so called, though establishing no legal cloud upon title, does affect free selling of land in bulk and virtually forces lottage with an actual increase in assessed valuation, yet there may be a practical decrease in real value. To attempt to try and overcome, in part, some of this injustice, the author suggested (and it was finally adopted in New York) the plan of preparing "tentative" maps, which were made from careful field and office studies with due relationship to estimated development, as well as to existing conditions.

Publicity is given to these maps, as a notice that the district at interest had been considered, so that property owners can at will, plan for desired improvements in accordance with a well thought-

out scheme of streets. When the owners reach the point of actual readiness to carry out the developments due notice is given and "final" maps are prepared having definitely established line and grade and from which legal proceedings can be begun looking to full public acquisition and dedication of the street areas.

The weak point still exists, however, that property owners are not bound by the tentative maps, but may ignore them and carry out their own schemes and after a period of 20 years, or so of public use of the streets (thus privately laid out) the city becomes forced to recognize their publicity, even though perhaps very inadequate as to location, line and grade.

Attempt has been made to cure this evil in some states by forbidding the use of any public utility in streets privately laid out which do not conform to an adopted municipal plan.

When a street plan shall have been completed for existing thorofares, contemplating a widening, or changing of grade, or other change of line; contrary to present custom, a requirement should be that upon the formal adoption of such plan, improvements shall be restricted, to conform to the new lines and grades, or carry a bar to the recovery of damages for improvements carried out according to the old lines and grades, together with another mandatory provision that the condemnation, or acquisition, or change of grade proceedings must be consummated within a reasonable specific time, either upon petition from property owners affected, or instituted as a matter of course by the city. This would give property owners a right, not now possessed, to practically force an important improvement through petition and would protect those who without compulsion have carried out improvements in accordance with such amended lines and grade. The same general rule, or law could be quite readily made to apply to entirely new layouts, with perhaps the exemption from taxation of lands within the adopted street lines, provided the owners would tender title to the city, without condemnation, and benefit and damage costs. As in most cases in large cities, the taking of property for streets is assessed directly upon the properties benefited, and much of it against frontage, there would not be so much injustice in carrying out the plan as might appear at first thought.

Many properties are sold today from a map prepared by private interests, having apparent official standing because noted as "filed

with the county clerk"; such filing does not indicate municipal adoption, but simply confirms right in such streets as are shown, to purchasers of properties fronting upon them and in no way debars the city from adopting later some entirely different layout with sometimes complete wrecking of the first plan. A law would be desirable forbidding County Clerks from receiving and filing any property layout which did not accord with an approved city plan.

Public Utilities.

Probably there will always be two kinds of sentiment in the handling of such public utilities as yield revenue; for those whose balance is always on the loss side, there will never be fear of private capital indulging; when there may be source of profit, usually, philanthropically inclined bankers and promoters can be found to devote their purses and brains to serving the public.

Advocates of general public ownership can see no good in letting any profit go to other individuals, hence the public must own and operate; the other class can see no economy in public officials running utilities.

In either event, to achieve success, righteous principles must control and all public rights must be considered, hence franchise and contract terms must be promulgated, covering requirements and restrictions duly prophetic as to probable future conditions. The thoughtful city student is needed in that important function.

Then there must be control of the use of public streets, differing somewhat, yet partly included in the police powers, limiting weights of vehicles and loads, widths of tires and speed, each having to do with wear and tear of pavements and due regard to integrity of sub-surface structures.

As to sub-surface structures, there must be sufficient knowledge as to character and location, to facilitate repair, connection and placing of additional ones; regulation of such must be assumed by a central authority or chaos will result and replacement of pavements become a disgrace.

Safety of structures and their suitability for use, requires peculiar attention, and some control.

The cupidity of the unscrupulous makes much necessary that otherwise could be left to ordinary natural laws of supply and demand and finance.

SUMMARY.

Education, Legislation and Regulation, Sanitation, Development, and Employment, all give field for the most intelligent activities of the best thinkers and doers.

Improvement is catching; the unconscious influence of better things, and quiet good examples, are equally potent factors in community physical betterment, as in personal growth.

A new building of artistic design soon influences other builders in the vicinity; a parked street intersection with a bed of flowers, will incite to the beautifying of a whole neighborhood; a well-kept clean thorofare shames those leading into it into better order; neatly uniformed city laborers not only adds to their self-respect and esprit-de-corps, but tempt other workmen to less slovenliness.

Suitable bright street lighting drives out crime; good work conditions tend to make happy efficient workers. May the day come when there can be two free days each week, one for physical rest and recreation, one for spiritual and mental upbuilding, when five days of labor will bring adequate return for seven days of comfortable living, and a little more.

Conservation of energy and effort, of material and time, are the problems to solve.

Development on lines of utility and beauty with convenience of service must be the aim of the worker.

Government in justice to all, by trained officials, who seek true economy and efficiency.

Legislation and regulation doing their part.

Helpfulness and education to further self-effort and lastly the provision of safeguarded opportunities for the investment and use of earnings and savings, coming more and more to be considered something of a public duty.

The twigs of the tree are many, the leaves countless can only be taken as a class, but must still be regarded as intelligent entities having feelings, aims and ambitions, to be educated, cared for, encouraged, rewarded and credited with their accomplishments that surely come when consecrated and concentrated brains are in control of the city at work.

REPORT OF THE COMMITTEE ON FIRE PREVENTION.

Alcide Chaussé, Chairman, Montreal, Canada.

As chairman of your Committee on Fire Prevention, I have, since the last Convention of the American Society of Municipal Improvements, attended two important meetings where Fire Prevention was discussed by men who have made a special study of this important subject.

One of these gatherings was the nineteenth annual session of the National Fire Protection Association, held in New York City, on 11th, 12th and 13th, May last. This association whose objects are "to promote the science and improve the methods of fire protection and prevention; to obtain and circulate information on these subjects and to secure the co-operation of its members in establishing proper safeguards against loss of life and property by fire" is already known to most of the members of this society, and those who were at the Boston Convention last year, will remember the very interesting paper on Fire Protection read by its secretary, Mr. Franklin H. Wentworth.

This meeting was attended by nearly 300 members and guests. The subjects covered were the following:

State Fire Prevention Associations,
Field Practice,
Electricity,
Heating and Ventilating Blower Systems,
Schoolhouse Construction,
Safety to Life (outside stair specifications),
Fire-Resisting Construction,
The Uses of Wood,
Automatic Sprinklers,
Electric Railway, Light and Power Properties,
Signaling Systems,
Explosives and Combustibles,

Window and Door Openings,
Building Regulations,
Gravity and Pressure Tanks,
Standards (Interior Standpipe Requirements),
Fire Pumps,
High Pressure Fire Service Systems,
Hydrants and Valves,
Uniform Requirements.

The resolutions adopted were as follows:

"The National Fire Protection Association assembled in New York City for its nineteenth annual meeting, advocates the following measures in its warfare against the needless sacrifice of human lives and property by fire:

(1) The encouragement of fire-resistive building construction through the adoption of improved building codes by all States, Cities and Towns; the inclusion in such codes of adequate rules for exit facilities based on the occupancy for all buildings, and the general recognition of the fact that although fire-resistive construction is of the greatest possible importance, it is of itself not sufficient. The lesson of the greatest factory fire of the year is that large industrial buildings, even if built of cement and steel, must be subdivided by fire walls and must have adequate means of stopping fires in their incipiency.

(2) The adoption of laws or ordinances requiring the installation of automatic sprinkler systems as fire extinguishing agents in all factories, commercial establishments and city blocks. The adoption of ordinances requiring the construction of fire division walls not only as a property protection device but as providing the best life-saving exit facility.

(3) The establishment by law of a Fire Marshal in every state, who shall not be a mere political office holder but a trained man with trained assistants competent to direct the work as statistician, educator and prosecutor.

(4) The investigation of the cause of all fires by public officials, and the enactment of laws fixing personal liability for damage resulting from fires due to carelessness or neglect.

(5) The consolidation of all legal forces so as to provide for the systematic inspection of all buildings by local firemen and technically trained building and factory inspectors so as to insure the vigorous enforcement of rules for cleanliness, good housekeeping, and the maintenance of safe and unobstructed exits, fire-fighting apparatus and other protective devices.

(6) The especial safeguarding of schools, theatres, factories and all other places in which numbers of people congregate or are employed.

(7) The vigorous state and municipal regulation of the transportation, storage and use of all inflammable liquids and explosives.

(8) A careful study of municipal water supplies, their adequacy and reliability with special reference to their adequacy in cases of conflagrations.

(9) The universal adoption and use of the safety match.

(10) The education of children and the public generally in careful habits regarding the use of fire.

In the furtherance of these objects we appeal for the co-operation of all citizens. We ask them to help in the dissemination of our valuable literature and in the use of the standards of fire protection so carefully worked out by our committees to the end that the lives and substance of our people shall not continue to be dissipated by a reckless and easily preventable waste."

The other meeting at which I had the good fortune to attend was the first Conference of Building Commissioners and Inspectors, which was also held in New York City, on 14th May, 1915.

The purpose of the conference, as outlined by its Chairman, Mr. R. P. Miller, Engineer for Building Committee of the New York Board of Aldermen, pointed out that different conditions and needs in various cities would tend to prevent the adoption of an absolute uniformity in code conditions and requirements, but that certain fundamental principles govern successful codes in all cities. It is to bring about a proper understanding and appreciation of these essentials, he said, that the conference has been called into being. Officials enforcing the building laws are essentially police officers, charged with accountability for public safety of life and buildings.

Building laws should provide only the essentials and prescribe only the purpose to be accomplished.

The first session was occupied by a discussion on the present tendency towards low floor loads, great discrepancy between different codes, hollow tile for outside and bearing walls, automatic sprinklers, and enclosure of stairways. During this discussion the following resolutions were adopted:

"That this Conference favors the requirements of certificates of occupancy for all buildings, to be issued by the building department, as means of preventing the use of any building for any purpose to which it is not suited in point of strength, fire protection, or other features."

"That this Conference advocates the more general use of automatic sprinklers in buildings where the nature of the occupancy and construction makes it advisable."

The Conference decided to form a permanent organization, holding annual conferences, each conference to be held in connection with the meeting of some national organization. The next Conference will meet early next spring.

I have noted during the past year the various resolutions adopted by a great number of societies and associations having in view fire prevention and some of the most interesting I reproduce here.

The Annual Convention of the International Association of Fire Engineers, held at New Orleans, in October, 1914, was one of the most important of the year, and the adoption of the following resolutions was one of the features of the meeting:

"Whereas, The International Association of Fire Engineers believes that no automobile pumping engine should be rated at a greater capacity than that at which it can be safely run for a period of several hours duration, and

Whereas, The capacity to which an engine can be forced for short intervals of time does not furnish a true estimate of the worth of a machine, and

Whereas, The annual tests held by the Exhibit Committee of the Association are believed to constitute a proper and sufficient test of the worth of a pumping engine,

Be It, Therefore, Resolved, That the National Association of Fire Engineers is opposed to the advertising or offering for sale of pumping engines at a higher rated capacity than that maintained during the annual convention test, and

Be It Further Resolved, That the Association urges the appearance in these tests of all pumping engines which may be offered for sale and suggests that no member of the Association permit the use of his name in vouching for rated capacity of any pumping engine not established by test at the annual convention, or at such meetings of the Committee on Exhibits of the Association as may be authorized during the year by the directors of the Association."

The seventeenth annual convention of the National Firemen's Association, held in December 1914, at Chicago, emphasized the value of selecting a definite line of endeavor and proceeding without deviation to the accomplishment of the end sought. This organization has been working for years for Fire Prevention and Protection.

I record with satisfaction the following recommendations for State legislation made by Fire Marshall Ole O. Roe, of Iowa, which were embodied in his annual report to the Governor:

1—Provision for inspection, both state and local, of electric wiring.

2—A gasoline storage law or a law making it mandatory upon municipalities to make provisions by ordinance for such storage.

3—Standardization of chimneys and flues in cities and towns.

4—Provision for inspection of gasoline and carbide lighting systems.

5—A law regulating moving picture shows, specifying the construction of the booth, the number of exits, width of aisles, seating, etc.

6—A law requiring county superintendents to report to the Department of Public Instruction the compliance or non-compliance, upon the part of teachers in the public schools, with the law requiring instruction in the causes and dangers of fire.

7—A law prescribing the duties and responsibilities of telephone companies and operators in the matter of receiving and promptly turning in fire alarms.

8—A law prohibiting the leasing of a building as a human habitation unless it measures up to a certain standard as respects both sanitation and safety from fire.

Before closing this report I may note that the campaign for the safe and sane Fourth of July has brought good results, and statistics show the steady progress of the safe and sane idea has saved considerable number of lives. In 1903 there were 466 deaths and last year only 40; it is hoped that in coming years this number will continually be lowered.

FIRE PREVENTION IN DETROIT.

By J. C. McCABE, Boiler Inspector, Detroit, Mich.

I wish to express my regrets because of my inability to attend the meeting of your Society to be held in Dayton, owing to the increased work in the office and lack of sufficient help to properly care for the volume of work.

I wish to say that the proposed code regulating the use, handling, storage and sale of inflammable liquids, which code was formulated by the National Board of Fire Underwriters and the National Fire Protection Association, is now the law in the city of Detroit, covering inflammable liquids and the products thereof. This is a most admirable regulation and could, with profit, be adopted in every city or state in this country.

We have found some appalling conditions existing about the city. In many instances we have found wash-tubs and other large vessels in basements of buildings where unscrupulous and ignorant persons were doing dry cleaning in a most hazardous manner.

We have had many nasty fires in garages and other places owing to the careless use of inflammable liquids. Yesterday a garage burnt up destroying seven machines, and a week ago yesterday a motorcycle shop burnt up and two lives were lost. It is going to be an up-hill job to bring the use of inflammable liquids down to a safe and sane level.

It may be of interest to you to know that since the first of January, 1915, this office has issued 1,762 inflammable liquid permits. The magnitude of this increase in the use of gasoline motors must, of

necessity, cause municipal and state authorities to provide more strict regulations covering the use, handling, storage and sale of such goods.

I believe the Society could consistently recommend the adoption, by cities and states, of the regulation formulated by the above mentioned authorities for the reason that it is the work of the two bodies best qualified in this country to recommend a safe and sane regulation. I would further add that we have had comparatively little friction in the city of Detroit over the enforcement of the regulation.

As you may know, my principal duties are in relation to boiler inspection and licensing of the engineers. I desire to say that since the last meeting of this society, the American Society of Mechanical Engineers has formulated a uniform code covering the construction and use of steam boilers. I would like to see the American Society of Municipal Improvements go on record as indorsing the standardization of boilers as proposed by the American Society of Mechanical Engineers.

This indorsement will have much weight in an educational way, both by acquainting members of the American Society of Municipal Improvements with such standardization and by the giving of such knowledge to the steam users interested who are usually slow in acquiring knowledge of such matters.

FLOOD PREVENTION IN THE MIAMI VALLEY.

Following is a brief account of the address by E. A. Deeds, president of the Miami Conservancy Board, which could not be printed verbatim as it was largely dependent on the pictures shown and they could not be procured for reproduction here.

Dayton has had a series of floods for years past, but, like every city, required a disaster to awaken her to the necessity of making adequate protection plans. It is very difficult to induce the public to have a thoro survey made of any civic as well as other matter. If Dayton had had a survey of the valley made years ago by competent engineers we could at least have foretold what would happen. I doubt, however, if we would have been able to convince the public without such a demonstration as that of 1913.

Photograph was shown of a flood in 1866. A diagram showed the dates and heights of various flood stages in the past.

The pictures of the 1913 flood began with one of the water first going over the levee with crowds of people watching it who had no idea of the diaster to follow, water later being 5 or 6 feet deep at the point where they were standing. Other pictures showed a general view of the city and one of the bridges with water from hill to hill, with depth of 6 to 20 feet; a panoramic picture; the business section with 8 or 10 feet of water, the current crossing the river at a bridge almost parallel with it.

The river capacity was about 80,000 second-feet and the flood carried 240,000 second feet, so that bridges had little to do with the height or extent of the flood.

Other pictures showed the streets at various stages of the flood, horses swimming until exhausted, the velocity of the current along the edge of the flood, lumber floating, the piling up of floated houses, the undermined and fallen tower of the high school building, some of the burned district, the debris in a large department store after the flood, merchandise dumped in the streets to be taken away, refugees cooking dinner in the street.

Pictures of the floods of 1866 and 1913 in Hamilton were shown, that city suffering in greater proportion in loss of life and property

than any other city in the valley. The big bridge starting to go out, the railroad tracks and buildings at the southern end of the city were also shown.

The Big Four bridge south of Miamisburg, the flood in Piqua and in Troy, the fertile fields denuded of soil and left covered with boulders and gravel were also shown.

After cleaning up the city the flood prevention committee which had been appointed looked for engineers to make a study of the situation and found the Morgan Engineering Company.

To pay the expenses a fund of $2,000,000 was started and in 6 days it was oversubscribed by 23,000 people by about $135,000, subscriptions to be paid in installments within 3 years.

The rainfall maps of 1910 and 1913 were shown to indicate that a recurrence of the flood at any time is not impossible. Consequently the reservoir control proposed is large enough to take care of a storm 50 per cent greater than that of 1913.

The drainage district map of the Miami Valley was shown with the topography which made flood control reservoirs possible at the sites shown, the gates in the dams being open at all times so that the ordinary floods pass by without restriction, the flood restriction only acting when the danger to the critical locations below becomes imminent. Details of the various dams and reservoirs and of the lands which may be flooded occasionally were given from the maps, which indicated the area which would be affected beneficially and damaged.

A diagram of a dam in perspective and in cross section was shown indicating the solidity and permanence of the proposed structures. A diagram of the flood flow of a week without and with the flood control dam showed clearly the effect of the dam in protecting the area below by holding back the peak of the flood and distributing it over a few following days. Every flood and storm for 23 years has been studied in the same way and it was shown that only once in that time would there have been any water held back by the dams during the crop season.

After the Morgan Engineering Co. made its report a consulting board, made up of Prof. D. W. Mead, J. W. Alvord, and Frank Woodward went over the plans. A special consulting board made

up in part of government engineers made an independent investigation. It included such men as General Ernst who was on both Panama Canal Commissions, J. W. Ackerman of the Mississippi River Commission, Morris Knowles of the Pittsburgh Commission, and others. These boards endorsed the work done and made recommendations: That the flood to be controlled should be assumed 20 per cent greater than that of 1913; that the district should include the whole Miami Valley above the entrance of the White Water river, else improvement for one section would damage another.

The estimated cost of the project for the area recommended is $17,000,000 to $20,000,000.

In a problem of this kind there is more than engineering. It was soon discovered that there were no adequate laws, the ditch laws not being on large enough scale and having too many independent bodies with conflicting interests which must be included in the governing bodies. All the laws of all the states and of foreign countries were worked over, in which work Mr. Morgan's experience in ten different states was of great assistance. After Mr. Morgan had prepared a bill taking care of the engineering features, Mr. McMahon took up the constutional questions and White and Oakley of Chicago those concerning the validity and salableness of the bonds, the last man to pass on these questions being John F. Dillon of New York. It took Mr. McMahon four months of continuous work to get the bill in shape to present to the legislature, with the aid of the other gentlemen mentioned and all of us.

There has been much opposition from interests affected, from those who could make more if matters were done differently, from those who thought they would be affected, from those who were ignorant of the consequences of the law. But there is no part of the law which does not have a counterpart in some law which has been adjudicated in some State of the Union, and, tho the law has been to the Supreme Court twice, in one or two circuit courts of appeals once or twice, and in the common pleas courts occasionally, it has always been approved.

The plan in brief is that the judges of the courts of common pleas in the counties interested shall meet and appoint a board of three directors of the conservancy district. Morton Rensselaer of Hamilton, Henry Allen of Troy, and E. A. Deeds of Dayton are

the present members of this board, who have the responsibility of starting the work. There are 92 engineers at work on the final plan, which, when approved by the board, may be objected to and must then go before the court of judges for a hearing, so that about 100 days pass before the decision is made. General Chittenden, Professor Mead and Mr. Morgan are giving part or all their time to the plan. Then comes the appraisal of the 100,000 or more pieces of property that will be benefited, the maps for which are prepared.

Six months was first thought to be the time necessary to begin construction but that time has not yet arrived, what with the engineering studies, the legislative gauntlet, the legal gauntlet, and the final plans running the latter. When work does begin on construction it can be finished in three years. And when it is finished the Miami Valley will never again suffer as it did in 1913, and it will be paid for by the people benefitted.

We had a loss in the valley which ran up into the hundred millions so that we are vitally interested in the prevention of another such loss and with public opinion in this whole mighty valley behind it, it is going thru.

It is an encouraging thing to see our municipalities, our counties and cities respond. It means better conditions all around. We have met the opposition fairly and will have our delays and trouble, but our directors stand as State men in an authoritative position in an established sub-division of the State of Ohio and we find that the right prevails as it always does in an undertaking of this kind, if it is only put on a big, safe, right basis to begin with.

REPORT OF COMMITTEE ON STANDARD FORMS.

By A. PRESCOTT FOLWELL, Chairman, New York City.

The committee on Standard Forms this year presents reports from the sub-committees on Street Cleaning and Refuse Disposal, Sidewalks and Curbs, and Sewer Construction and Maintenance. Mr. Sawin, the sub-committee on Street Lighting, reports that he can make no suggestion as to changes in the form previously recommended and which has already been printed in the Proceedings of the Society.

No sub-committee was appointed under the head of Street Paving and Repairs, nor on the subject of Uniform Bidding Blanks, for reasons which are explained further on in this report.

The report of the sub-committee on Street Cleaning and Refuse Disposal is as follows:

REPORT OF SUB-COMMITTEE ON STREET CLEANING AND REFUSE COLLECTION AND DISPOSAL, J. T. FETHERSTON.

The standard forms of report on street cleaning, refuse collection and disposal were sent out to about sixty cities in 1914, and about thirty replied in more or less detail.

The *Municipal Journal* on December 18th, 1914, published replies from one hundred and fifty cities and in commenting on the returns stated, "these tables include more cities than could have furnished the information a few years ago, and the developments just mentioned, together with a more general keeping of accounts, will, we hope, make it possible to add many cities to the list during the next few years."

Apparently the forms have proved successful in that many cities are able to provide data which formerly were lacking.

The next step is to make use of the information, as otherwise the statistics represent just so much wasted time and effort. Comparisons on a broad relative basis should be of service to street cleaning officials and the table given herewith shows a reduction to a uniform basis of the standard form data from seventeen cities. No attempt is made to draw any conclusions from the figures, which are simply presented for discussion by those interested.

SUMMARY OF STREET CLEANING DATA COLLECTED 1914 STANDARD FORMS A. S. M. I.

CITY.	CLEANING OF STREETS. Length of Streets, Miles.	Area of Streets, Sq. Yds.	Population.	Street Sweepings, Cu. Yds. per year.	Number of Sweepers and Drivers.	Miles of Streets per Sweeper and Driver.	Area pavement per Sweeper and Driver. Sq. Yds.	Population per Sweeper and Driver.	Street Sweepings per 1,000 sq. yds. pavement per yr. Cu. Yds.	REFUSE COLLECTION. Population.	Number of Collectors.	Material collected per year. Cu. Yds.	Population per Collector.	Material per collector per annum. Cu. Yds.	Cu. Yds. Material per 1,000 population per year.
New York {Manhattan, Brooklyn, Bronx}	1,433	28,481,042	5,118,283	859,539	3,039	0.47	9,372	1,684	30.20	5,118,283	1,878	7,429,858	2,725	3,956	1,452
Washington, D.C.	251	7,629,432	353,297	93,328	362	0.70	21,076	976	12.30	353,297	Contract 240	440,368	1,472	1,834	1,244
Newark, N. J.	238	5,060,980	395,000	123,322	279	0.86	18,130	1,416	24.80	395,000	Contract 175	642,236	2,257	3,669	1,626
Cambridge, Mass.	112	Not given	110,000	Not given	42	2.66	.....	2,619	....	110,000	50	162,000	2,200	3,240	1,472
Grand Forks, N. D.	13	230,000	14,000	Not given	10	1.30	23,000	1,400	....	10,000	3	Not given	3,333	....	....
Columbus, O.	240	Not given	200,000	59,172	78	3.07	.....	2,564	....	200,000	85	125,000	2,353	1,471	625
Columbia, S. C.	5.50	202,792	50,000	Not given	10	0.55	20,279	5,000	....	50,000	24	Not given	2,083	....	......
Hartford, Conn.	12.50	294,300	112,000	Not given	45	0.28	6,540	2,488	....	112,000	66	164,180	1,696	2,487	1,466
Minneapolis, Minn.	96	2,610,687	350,000	60,900	164	0.59	15,919	2,134	23.30	300,000	73	109,634	4,109	1,502	365
Cincinnati, O.	608	9,959,328	400,115	128,030	301	2.02	33,084	1,829	12.80	400,115	128	306,423	3,126	2,393	766
Boston, Mass.	254	3,527,195	729,072	207,802	383	0.66	9,212	1,904	58.90	729,072	656	956,570	1,111	1,458	1,311
Toronto, Ont., Canada.	521	7,260,186	475,575	237,678	452	1.15	16,062	1,052	32.70	475,575	381	845,903	1,248	2,220	1,780
New Orleans, La.	288	Not given	373,000	28,620	340	0.85	.....	1,097	....	373,000	180	509,689	2,072	2,831	1,866
Winnipeg, Man., Canada.	159	2,263,997	203,255	87,720	234	0.68	9,675	869	39.20	203,255	78	cannot be separated.	2,605	....	....
Baltimore, Md.	571	6,585,138	558,485	268,828	415	1.37	15,868	1,346	40.80	558,485	197	647,951	2,835	3,288	1,160
Philadelphia, Pa.	1,071	17,059,545	1,650,000	Contract 395,000	1,097	0.98	15,551	1,504	23.10	1,650,000	Contract 600	2,004,000	2,750	3,340	1,214
Erie, Pa.	65	1,385,107	85,000	Not given	80	1.20	16,689	1,063	....	85,000	11	10,850	1,063	986	128
Averages						1.14	16,462	1,785	29.76				2,296	2,477	1,141

REPORT OF SUB-COMMITTEE ON SIDEWALKS AND CURBS, HARRY F. HARRIS.

The report of the sub-committee on Sidewalks and Curbs, Harry F. Harris, is as follows:

"After considerable study, this Committee believes that more real progress can be made in ultimately adopting a permanent and standard form, if it at this time simply devotes its energies toward having standard units adopted, rather than standard forms.

"If it can induce the Society to adopt the standard units suggested or substitutions therefor, it will feel that considerably more has been accomplished, than if a form considered in a more or less hurried or perfunctory manner (to which serious objections might be offered later) had been adopted, and then used by numerous cities thruout the country. This would bring about a condition almost as objectionable as the existing one (that of having no standard at all), which condition this Society is striving to correct. Furthermore, the entire arrangement of the form would depend primarily upon the units used.

"In view of the above, the Committee recommends that all cities in reporting prices for sidewalk work, should separate all items pertaining to the cost of foundation, drainage, reinforcement and excavation from that of 'Sidewalk', and under the heading of 'Sidewalk' should be included all items of cost not included under the items of 'foundation', 'reinforcement', drainage' and 'excavation.' It also believes that the square yard should be the unit adopted; but in stating the price per square yard, the reporter should state whether the walk (if of concrete) is of one-course or two-coure construction, the proportions and depth of each course and kind of aggregate used. If the walk be of brick or flag, the total depth of brick or flag should be stated with the price and be accompanied by a concise description of the material. Should the walk be a bituminous one, the depth and a short explanation should be given relating to the proportions and nature of construction.

"In short, the aim of the Committee is to have all variables eliminated as much as possible, in order that true and valuable comparisons may be made when figures are given or reported, without extended and involved foot notes and explanations.

"As to curb, it is recommended that the linear foot be the unit adopted, but that this unit should always be accompanied by the size

of the curb expressed in inches of depth by average inches of width, and the name of material, thus: '10,000 linear feet of 6″ x 18″ concrete curb.

It is also recommended, as in the case of sidewalks, that the cost of excavation, drainage and foundation and steel reinforcement should be separated entirely from the cost of curb, so that all the constants may be compared with some degree of accuracy.

"It is also recommended that, in the case of stone curb, the dressing also be stated, ex., 10,000 linear feet 6″ x 18″ 6-ax granite curb.

"Combined concrete curb and gutter should likewise be expressed in linear feet, and the cross-section given as total area in square inches, thus: '10,000 linear feet of 212 square inches concrete curb and gutter, 1: 2½: 5 mix'.

"Where the gutter is separated from the curb, the Committee would suggest that the gutter be treated on the same basis as the roadway paving, namely, using the square yard as the unit and handled in the manner heretofore adopted and recommended by this Society under pavement forms. In other words, where combined with the curb, it would seem logical to treat the gutter as an integral part of the curb, and where separated on the square yard basis."

Report of Sub-Committee on Sewer Construction and Maintenance, E. S. Rankin.

The sub-committee on Sewer Construction and Maintenance, E. S. Rankin, reports as follows:

"At the convention last year, your sub-committee on Sewer Construction and Maintenance presented three forms for sewerage work, two of which were recommended for adoption and were adopted, and the third was presented for consideration and suggestions, with a number of questions which appear on Page 492 of the report.

"The only suggestion that was made at the convention was that the Society adopt the form of the Boston Society of Civil Engineers. No answer was received at that time or since to any of the questions, and the committee therefore finds itself in the same position in which it was last year. It is the opinion of the committee that the Boston form is almost too elaborate and that a third form on the lines presented

last year, together with the two already adopted, would give all the information necessary and make more easily comparable the statistics of different cities.

"We would therefore recommend that this committee be continued for another year, with a view to presenting a final report on this form at the next convention.

In connection with the matter of terms used in sewerage work, the committee would like to make the following report and recommendations:

"Dictionaries have standardized language until there is little dispute as to the meanings of words in common use. Also purely scientific terms have definite meanings which are generally agreed upon.

"But there is considerable confusion as to the meaning of many words and phrases used in the applied sciences. We would call attention to a few of those used in sewerage work, and suggest standard definitions for them. Until there is a general agreement on these or some other terms as standard, there will be more or less confusion and uncertainty in written and oral discussions on sewerage matters.

"Exactly, what is an inlet? a catchbasin? a trap? And what is the proper name for sewers which carry the water which enters thru catchbasins, and what for sewers which carry water coming from houses? And what for the dirty water that flows in each?

"These are a few of the terms which should be standardized. To us the proper terms and definitions seem clear, and yet our views are not shared by all, to judge by the literature on the subject. Our own ideas as to the terms to be applied to such structures and liquids are as follows:

"An inlet is any structure receiving water from the street. It consists essentially of an opening in the gutter (gutter inlet) or in the curb face (curb inlet) or between the rails of a track (track inlet) and a pipe leading from this to the sewer. This is a plain inlet. The opening is always covered with an inlet grating when in gutter or track. If there is a basin below the opening to catch dirt, it is a catchbasin inlet, or simply catchbasin; the portion vertically below the outlet pipe being the catchbasin.

"A sewer which receives rain water from the street only is generally called a storm water sewer or storm sewer, and the water which

flows in it is called storm sewage or surface water. But some call these 'drains', a palpable misnomer, in our opinion, which confuses this purpose with that of draining subsurface water from land. Sub-drains are properly so named, for they are to remove ground water; but drain tile, used for this purpose, are certainly not suitable for constructing these so-called 'drains.' Storm sewers certainly do not drain the ground (unless incidentally), but remove storm water. To call them drains is incorrect and leads to confusion with real drains, which are designed to take in water thru the joints.

"The sewage which is discharged into sewers from houses is called by the engineers 'sanitary sewage.' Some liquids are entitled to be called sanitary ('tending to preserve health'), but to apply this term to that under discussion seems to us the height of absurdity. As well call rat poison a sanitary food, because it removes rats, which sometimes carry germs of disease. 'House sewage' is a shorter term and describes it exactly—it is the sewage which comes from houses. Consequently 'house sewer' may be applied to the sewer which carries this liquid. The only objection we can think of to this use of this term is that it is also used to describe the pipe from house to sewer; but this may, and we think should, be called a 'house connection'—just as the pipe from a catchbasin to sewer is called a 'basin connection.'

"The usage to which exception is taken in the two last paragraphs has the support of some men of the highest standing in the profession; but the same is true of meanings here suggested also. We hope that this matter will be fully discussed for a few minutes; that this Society will place its seal upon a definite usage of the terms referred to; and then that all of the members will adopt and faithfully adhere to the usage so recommended."

The committee wishes again to emphasize the importance which it places upon giving the most widespread publicity to the actions of this Society in adopting these forms, with a view to securing a more or less general use of them by the cities of the country. As the Chairman stated in his remarks at the convention two years ago, the Society at one time adopted standard forms for most of the department work conducted by our municipalities, with a recommendation that they be adopted and used generally by the cities; and two or three years later a member of the Society rose in convention to suggest that this Society adopt some standard forms of this kind, as they would be of the great-

est value to the cities which were represented in the Society, and not a member present at the convention seemed to remember that this thing had actually been done only two or three years previous. The mere preparing and adopting of forms is an absolute waste of the time of both the Society and the members of the committee, if the matter is to stop there.

It has seemed to the committee that one of the reasons for the failure of several previous efforts at introducing standard forms has been the fact that the promoters of them were too ambitious and desired to change the entire record-keeping of the cities of the country to conform to their ideas. Our aim is much more modest so far as present results are concerned. As reported last year, it seems to us that a great advance will have been made if we can persuade the cities generally to adopt standard *units* to be employed in all reports and calculations dealing with work of the kind in question. Such units are fundamental to the adoption of anything like uniform methods of reporting public work, and until they have received more or less general acceptance, it is useless to endeavor to secure the general use of standard forms based upon them.

The committee, therefore, believes that it will make most progress by moving slowly in the way of new proposals as to either standard units or standard forms, but should devote a large part of its energies toward securing more general adoption by the cities of those already recommended to and adopted by the Society. This year we recommend the adoption of the units proposed by the sub-committee on Sidewalks and Curbs, and the terms proposed by the committee on sewer construction and maintenance, which we hope will receive full discussion by the Society and be modified by it if it thinks desirable. What we desire in these, as in the other forms, is not so much the adoption of the exact forms recommended by the committee (altho these have been carefully considered and it seems to us best meet the requirements), but the important thing is that those units be selected which will be most apt to receive the approval of the greatest number of cities, and so be most generally adopted by them.

We, therefore, suggest that the Society consider the units which it has already adopted, together with those for Sidewalks and Curbs recommended herein; and that, having finally approved of these, it authorize and direct the committee on Standard Forms to use a large part of its endeavors during the coming year to give these standard

units the widest publicity possible among those city officials who are engaged in the classes of public work in which they would be used, and to endeavor to persuade said officials to adopt these units. In other words, the committee proposes that it carry on a publicity campaign for the purpose of effecting the second and more important (and likewise more difficult) part of the work which must be done if its labors are to be of any real benefit. If it is to be given this authority it will, or course, be necessary to authorize it to spend a certain amount of money in postage and printing; altho it will undoubtedly make such use as it can of periodicals which deal with municipal matters, by asking them to publish in their editorial pages articles and letters on the subject.

At the same time, it seems to us desirable that the work of selecting standard units be continued thru the sub-committees with the idea that, as unit after unit is adopted by the Society, these may be added to those which publicity is being given.

The matter of adopting units will in a number of cases consist more in a defining of what is meant by the unit than mere adopting of the name, since the latter is already pretty well settled upon in a great many cases. An illustration of what we mean is the term "Hand Sweeping of Streets." When a city states that it cost so many cents per thousand square yards for sweeping streets by hand during a certain year, the statement is indefinite for two reasons: First, it is not certain whether the area used as the basis of calculation was the actual area of pavement which was cleaned over and over again during the year, or referred to the area of cleaning done once, which cleaning may have occurred on a given area of pavement daily thruout the year. Second, there is no general understanding of what is included in the expression "Hand Sweeping." This generally includes the picking up of the sweepings and depositing them in bags or cans carried on hand carts by the sweepers, but does it include the removal of the sweepings by cart, and if so, how far are the sweepings carried? Does it include a sprinkling of the street by a patrolman immediately before sweeping? Does it include picking up of papers and rubbish? Is the same area cleaned also by machine sweeper, and if so, how often; and is this cost of machine sweeping of the area in question included in the cost of cleaning by hand sweeping? It is very evident from this illustration that the mere selecting of a term or name for a standard unit is only the beginning, and that a much more important duty is the exact defining of what work should be included in the unit adopted.

This selection and defining of units may well occupy this committee for several years to come, entirely aside from any work which it may undertake in endeavoring to secure the adoption of standard units previously and from time to time agreed upon.

The units already adopted by the Society are: The separation of street improvement into excavation, in cubic yards, classifying material excavated; base, in square yards of stated thickness; curb, new or reset; and wearing surface, including all construction of this nature which comes above the base—cushion or binder, if any, as well as wearing surface proper.

In sewerage, the running foot of sewer, stating size, and depth within two-foot intervals (8 to 10 ft., 10 to 12 ft. etc.), all branches or other special constructions being included in the linear feet, but being also recorded and paid for as separate items; separate items also being made of replacing pavement. Manholes are recorded and paid for as so many of a stated minimum depth, plus so many vertical feet of extra depth. Also Form 1, for reporting main details of sewers built during the year; and Form 2, a condensed form for this and for reporting the entire sewer system.

A form for reporting data concerning street lighting.

The units suggested this year for adoption are: For sidewalks—surface, by the square yard, naming thickness and whether one or two-course, and proportions of mixture, if of concrete; this to include only the material above the foundation, the excavation, drainage, foundation and reinforcement being given as separate items. For curbs, or combined curb and gutter—linear feet, given sectional area in square inches and brief description of material; this not to include excavation, drainage, foundation or reinforcement, these to be given separately. For gutter, if separate,—the unit to be the square yard, giving thickness and material; excavation and foundation being separate. For sewerage—the use of the terms inlet, catchbasin, storm sewer, house sewer, house sewerage, house connection, basin connection, as defined in the report.

REPORTS OF COMMITTEE ON STANDARD SPECIFICATIONS.

The report of the Committee on Standard Specifications as made to the Society and the discussion thereof will be found on page 513 in the Business Proceedings of the Convention, and the reports of the sub-committees which give but a few changes or corrections in last year's specifications, as follows:

Sub-Committee on Specifications for Sewers, page 516.

Sub-Committee on Specifications for Asphalt Paving, page 520.

Sub-Committee on Specifications for Brick Paving, page 518.

On the following pages will be found the reports of sub-committees which presented full new sets of specifications or changes which were so extensive as to require re-printing of the whole specification. These reports are the following:

Special Sub-Committee on Specifications for Concrete Paving, page 390, discussion on page 403.

Minority of Sub-Committee on Bituminous Concrete Paving Specifications, page 408, and the majority report with discussions on page 522.

Sub-Committee on Specification for Broken Stone and Gravel Roads, page 424, discussion on page 442.

Sub-Committee on Specifications for Stone Block Paving, page 446.

All of the above named reports were adopted and the specifications and changes therein were adopted.

The report of the Sub-Committee on Wood Block Paving was presented to the Society and was held over for further consideration and information until the next Convention. This report is given on page 529 in the Business Proceedings and the specifications will be found on page 456. They are followed by suggestions as to other specifications for oils for treating blocks, which were invited by the Committee on Standard Specifications and reached the Secretary before Feb. 1, 1916. These suggestions are from P. C. Reilly, page 466, W. H. Fulweiler, page 467, C. N. Forest, page 467, J. W. Howard, page 469.

REPORT OF SPECIAL SUB-COMMITTEE ON SPECIFICATIONS FOR CONCRETE PAVING.

As a special committee appointed and directed by you today, to present at this meeting recommendations for specifications for concrete pavements, I have the honor to submit herewith a brief specification for a one-course concrete street pavement and one for a two-course concrete street pavement.

I would respectfully urge their approval by your committee and their adoption by this Society.

I should not fail to call your attention to the fact that in each case the specification as proposed is largely based on the respective specifications adopted by the American Concrete Institute, February, 1915, and to acknowledge my indebtedness to the latter Society for the material assistance derived from its work on this line.

The American Concrete Institute specifications have furnished verbatim many of the clauses contained in the specifications proposed as it seemed wise not to lose, by attempting minor changes, the opportunity offered to further uniformity. On the other hand, some of the clauses submitted are totally different from the American Concrete Institute specifications, (notably in the proportioning of the mixes) and they have been made so because of my conviction that this opportunity for material improvement on such points ought not to be neglected.

It is also but fair to state that I believe, especially in view of the haste with which I have been obliged to conduct this work, that further improvement may be anticipated in a further report in this matter another year by a larger committee, such, for instance, as your regular sub-committee on concrete paving. This should be particularly true if the proposed specifications shall be adopted now by the Society and thereby placed before its committees and membership for detailed consideration.

W. W. Crosby,
Special Committee on Concrete Paving.

The discussion will be found on page 403.

SPECIFICATIONS FOR CONCRETE STREET PAVEMENT.

Adopted October 14, 1915.

These specifications will be modified from time to time to keep them fully up to date. Suggestions as to modifications or additions are solicited and should be sent to the Secretary, or to William J. Hardee, City Engineer, New Orleans, La., Chairman of the Sub-Committee on Specifications for Concrete Paving, and George W. Tillson, Boro Hall, Brooklyn, New York, Chairman of General Committee on Standard Specifications.

ONE-COURSE PAVEMENT.*

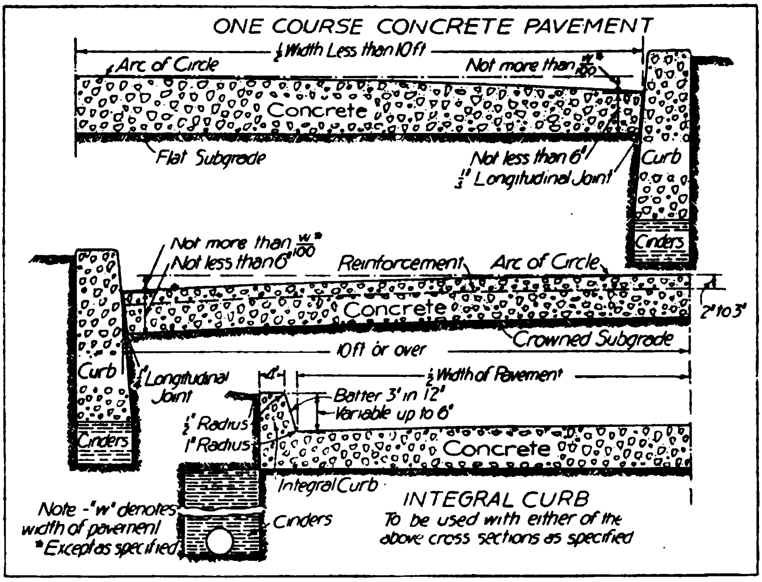
1. Materials.

1. Cement.—The cement shall meet the requirements of the Standard Specifications for Portland Cement, adopted by the American Society for Testing Materials, August 16, 1909, with all subsequent amendments and additions thereto adopted by said Society.

2. Fine Aggregate.—Fine aggregate shall consist of natural sand or screenings from hard, tough, durable crushed rock or gravel, consisting of quartzite grains or other equally hard material graded from fine to coarse, with the coarse particles predominating. Fine aggregate, when dry, shall pass a screen having four (4) meshes per linear inch; not more than twenty-five (25) per cent shall, pass a sieve having fifty (50) meshes per linear inch, and not more than five (5) per cent shall pass a sieve having one hundred (100) meshes per linear inch. Fine aggregate shall not contain vegetable or other deleterious matter nor more than three (3) per cent of clay or loam.

Fine aggregate shall be of such quality that mortar composed of one (1) part Portland cement and three (3) parts fine aggregate, by weight, when made into briquettes, shall show a tensile strength (at seven (7) and twenty-eight (28) days) at least equal to the strength of briquettes composed of one (1) part of the same cement and three (3) parts Standard Ottawa sand by weight. The percentage of water used in making the briquettes of cement and fine

*Specifications regarding both joints and reinforcement are purposely omitted from these specifications, in order that the freest opportunity may be afforded for their addition, in any particular case, according to the opinions of the engineers in charge under the local conditions.



aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand briquettes of Standard consistency. In other respects all tests shall be made in accordance with the Report of Committee on Uniform Tests of Cement of the American Society of Civil Engineers.

3. Coarse Aggregate.—Coarse aggregate shall consist of clean, tough, crushed rock or gravel, or slag of approved quality in graded sizes, free from vegetable or other deleterious matter and containing no soft, flat or elongated particles.

The sizes of the coarse aggregate shall be such as to pass a one and one-half (1½") inch round opening, and shall range from one and one-half (1½") inch down, not more than five (5) per cent passing a one-quarter (¼") inch round opening, and with no intermediate sizes removed.

Its "Coefficient of wear" as determined by the "Deval Test" shall not be less than twelve, and its crushing strength shall not be less than twenty thousand (20,000) pounds per square inch.*

2. Proportions.

4. All proportions of cement, fine aggregate and coarse aggregate shall be determined on the basis of volumetric analysis, with a view

*Figures should be suited to local conditions.

to obtaining a uniform density for the resulting concrete.

5. An examination of the coarse aggregate to be used shall be made and the voids therein determined. The amount of mortar (fine aggregate and cement mixed with water) to be used shall then exceed these voids in volume by not less than five (5) nor more than ten (10) per cent of the total mass of the coarse aggregate.

6. An examination of the fine aggregate to be used shall be made and the voids therein determined. The amount of cement to be used shall then exceed these voids in volume by not less than five (5) nor more than ten (10) per cent of the total mass of the fine aggregate.

(Added by General Committee.)

In no case shall the volume of fine aggregate be less than one-half the volume of the coarse aggregate, nor shall the proportion of cement to fine aggregate be leaner than one (1) to two (2). A cubic yard of concrete in place shall contain not less than seven sacks of cement.

7. The amount of water to be used shall be determined by trial mixtures with the coarse aggregate, fine aggregate and cement in the proportions as above determined until a satisfactory consistency is obtained in the wet concrete, which consistency shall be such as to permit the concrete to be readily deposited in place and yet hold its shape when struck off by the template and at the same time not to bring about a segregation of the different sizes of material in handling. Every effort and precaution shall be used to secure a constant uniformity in the consistency of the mix.

3. Sub-Grade.

8. Construction.—The bottom of the excavation or the top of the fill when completed shall be known as the sub-grade and shall be at all places true to the elevation as shown on the plans attached hereto.

The sub-grade shall be brought to a firm, unyielding surface by rolling the entire area with a self-propelled roller weighing not less than five (5) nor more than ten (10) tons, and all portions of the surface of the sub-grade which are inaccessible to the roller shall be thoroly tamped with a hand tamp weighing not less than fifty (50) lb., the face of which shall not exceed one hundred (100)

sq. in. in area. All soft, spongy, or yielding spots and all vegetable or other perishable matter shall be entirely removed and the space refilled with suitable material.

When considered necessary or of assistance in producing a compact, solid surface, the sub-grade before being rolled shall be well sprinkled with water.

When the concrete pavement is to be constructed over an old pavement composed of gravel or macadam, the latter shall be entirely loosened and the material spread for the full width of the pavement and rolled. All interstices shall be filled with fine material and rolled to make a dense, tight surface.

9. Acceptance.—No concrete shall be deposited until the sub grade is checked and accepted by the engineer.

4. Forms.

10. Materials.—Where forms are required, they shall be free from warp, of sufficient strength to resist spring out of shape. Wooden forms shall be of not less than two-inch stock.

11. Setting.—The forms shall be well staked or otherwise held to the established line and grades. Where the curb is to be constructed integrally with the pavement, the upper edge of the side forms shall conform to the top of the curb.

12. Treatment—All mortar and dirt shall be removed from the forms that have previously been used.

13. Precautions shall be taken to prevent leaks thru side forms that would allow the cement or mortar to be carried out of the coarser aggregate along the edges of the roadway.

5. Measuring Materials and Mixing Concrete.

14. Measuring Materials.—The method of measuring the materials for the concrete, including water, shall be one which will insure separate and uniform proportions of each of the materials at all times. A bag of Portland cement (94 lb. net) shall be considered one (1) cu. ft.

15. Mixing.—The materials shall be mixed in a batch mixer of approved type and mixing shall continue after all materials are in

the drum for at least one (1) minute at a minimum speed of twelve (12) revolutions per minute. The drum shall be completely emptied before receiving materials for successive batches.

16. Re-Tempering.—Re-Tempering of mortar or concrete which has partially hardened, that is, re-mixing with or without additional materials or water, shall not be permitted.

6. Placing Concrete.

17. Placing Concrete.—Immediately prior to placing the concrete, the sub-grade shall be brought to an even surface. The surface of the sub-grade shall be thoroly wet, but shall show no pools of water when the concrete is placed.

After mixing, the concrete shall be deposited rapidly upon the subgrade to the required depth and for the entire width of the pavement in successive batches and in a continuous operation without the use of intermediate forms or bulkheads between expansion joints.

In case of a breakdown, concrete shall be mixed by hand to complete the section or an intermediate transverse joint placed at the point of stopping work. Any concrete in excess of that needed to complete a section at the stopping of work shall not be used in the work.

18. Finishing.—The surface of the concrete shall be struck off for the entire width of the pavement and from back to back of integral curbs when used, by means of a template or strikeboard. Any holes left by removing any material or device used in constructing the joint shall be immediately filled with mortar composed of one (1) part cement and two (2) parts of fine aggregate. Concrete adjoining metal protection plates of transverse joints shall be dense in character and shall be given a smooth finish with a steel trowel for a distance of six (6) in. on each side of the joints.

After being brought to the established grade with the template or strikeboard, the concrete shall be finished from a suitable bridge, no part of which shall come in contact with the concrete. If approved by the engineer, the contractor may use a mechanical striking and finishing machine. The concrete shall be finished with a wood float in a manner to thoroly compact it and produce a surface free from depressions or inequalities of any kind.

The finished surface of the pavement shall not vary more than one-quarter (¼) in. from the true shape.

7. Protection.

19. Curing and Protection.—Excepting as hereinafter specified, the surface of the pavement shall be sprayed with water as soon as the concrete is sufficiently hardened to prevent pitting, and shall be kept wet until an earth or other approved covering is placed. As soon as it can be done without damaging the concrete, the surface of the pavement shall be covered with not less than two (2) in. of earth or other material approved by the engineer, which cover shall be kept wet for at least ten (10) days. When deemed necessary or advisable by the engineer, freshly laid concrete shall be protected by canvas until such covering can be placed.

Under the most favorable conditions for hardening in hot weather, the pavement shall be closed to traffic for at least fourteen (14) days and in cool weather for an additional time, to be determined by the engineer.

At the season of the year when the average temperature is below 50 degrees Fahrenheit, sprinkling and covering of the pavement may be omitted at the direction of the engineer.

The contractor shall erect and maintain suitable barriers to protect the concrete from traffic and any part of the pavement damaged from traffic or other causes, occuring prior to its official acceptance, shall be repaired or replaced by the contractor at his expense, in a manner satisfactory to the engineer. Before the pavement is thrown open to traffic the covering shall be removed and disposed of as directed by the engineer.

20. Temperature Below 35 Degrees Fahrenheit.—Concrete shall not be mixed or deposited when the temperature is below frezing.

If at any time during the progress of the work the temperature is, or in the opinion of the engineer will, within twenty-four (24) hours drop to thirty-five (35) degrees Fahrenheit, the water and aggregates shall be heated, and precautions taken to protect the work from freezing for at least ten (10) days. In no case shall concrete be deposited upon a frozen sub-grade.

Two-Course Pavement.*

1. Materials.

1. Cement.—The cement shall meet the requirements of the Standard Specifications for Portland Cement, adopted by the American Society for Testing Materials, August 16, 1909, with all subsequent amendments and additions thereto adopted by said Society.

2. Fine Aggregate.—Fine aggregate shall consist of natural sand or screenings from hard, tough, durable crushed rock or gravel, consisting of quartzite grains or other equally hard material graded from fine to coarse, with the coarse particles predominating. Fine aggregate, when dry, shall pass a screen having four (4) meshes per linear inch; not more than twenty-five (25) per cent shall pass a sieve having fifty (50) meshes per linear inch, and not more than five (5) per cent shall pass a sieve having one hundred (100) meshes per linear inch. Fine aggregate shall not contain vegetable or other deleterious matter nor more than three per cent of clay or loam.

Fine aggregate shall be of such quality that mortar composed of one (1) part Portland cement and three (3) parts fine aggregate, by weight, when made into briquettes, shall show a tensile strength (at seven (7) and twenty-eight (28) days) at least equal to the strength of briquettes composed of one (1) part of the same cement and three (3) parts Standard Ottawa sand by weight. The percentage of water used in making the briquettes of cement and fine aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand briquettes of Standard consistency. In other respects all tests shall be made in accordance with the Report of Committee on Uniform Tests of Cement of the American Society of Civil Engineers.

3. Coarse Aggregate.—Coarse aggregate shall consist of clean, tough, crushed rock or gravel, or slag of approved quality, in graded sizes, free from vegetable or other deleterious matter and containing no soft, flat or elongated particles.

The sizes of the coarse aggregate shall be such as to pass one and one-half (1½″) inch round opening and shall range from one and

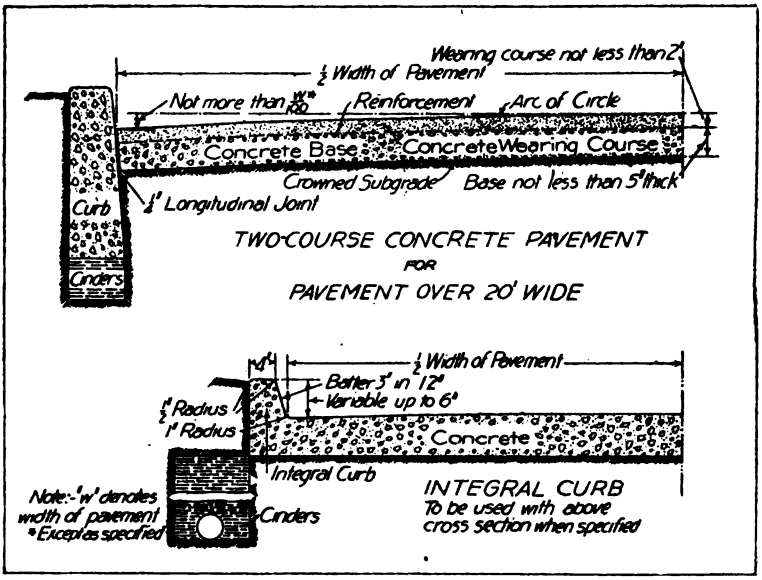
*Specifications regarding both joints and reinforcement are purposely omitted from these specifications, in order that the freest opportunity may be afforded for their addition, in any particular case, according to the opinions of the engineers in charge under the local conditions.

one-half (1½″) inch down, not more than five (5) per cent passing a one-quarter (¼″) inch round opening.

Its "coefficient of wear" as determined by the "Deval test" shall not be less than twelve (12) and its crushing strength shall not be less than twenty thousand (20,000) pounds per sq. in.*

No. 1 Aggregate for Wearing Course.

No. 1 aggregate for the wearing course shall consist of that portion of the above described coarse aggregate, which, when dry, will pass a one-half (½″) inch round opening and contain not more than ten (10) per cent of the fine material which will pass a one-quarter (¼″) inch round opening.



No. 2 Aggregate for Wearing Course.

No. 2 aggregate for the wearing course shall consist of that portion of the above described course aggregate, which will pass a one (1) inch round opening, ranging in size from one (1) inch down and containing not more than five (5) per cent of fine material that will pass a one-quarter (¼″) inch round opening, and with no intermediate sizes removed.

*Figures should be suited to local conditions.

2. Proportions.

4. All proportions of cement, fine aggregate and coarse aggregate shall be determined on the basis of volumetric analysis, with a view to obtaining a uniform density for the resulting concrete.

5. An examination of the coarse aggregate to be used shall be made and the voids therein determined. The amount of mortar (fine aggregate and cement mixed with water) to be used shall then exceed these voids in volume by not less than five (5) nor more than ten (10) per cent of the total mass of the coarse aggregate.

6. An examination of the fine aggregate to be used shall be made and the voids therein determined. The amount of cement to be used shall then exceed these voids in volume by not less than five (5) nor more than ten (10) per cent of the total mass of the fine aggregate.

7. The amount of water to be used shall be determined by trial mixtures with the coarse aggregate, fine aggregate and cement in the proportions as above determined until a satisfactory consistency is obtained in the wet concrete, which consistency shall be such as to permit the concrete to be readily deposited in place and yet hold its shape when struck off by the template and at the same time not to bring about a segregation of the different sizes of material in handling. Every effort and precaution shall be used to secure a constant uniformity in the consistency of the mix.

(Added by General Committee.)

In the base the volume of the fine aggregate shall not be less than one-half (½) the volume of the coarse aggregate nor shall the proportion of cement to fine aggregate be leaner than one (1) to two and one-half (2½). A cubic yard of concrete shall contain not less than five and one-half (5½) sacks of cement.

In the wearing surface the volume of fine aggregate shall not be less than one-half (½) the volume of mixture No. 1, nor shall the proportion of cement to fine aggregate be leaner than one (1) to one (1). A cubic yard of concrete for wearing course in place shall contain not less than twelve (12) sacks of cement.

In the wearing surface the volume of fine aggregate shall not be less than one-half (½) the volume of mixture No. 2, nor shall the proportion of cement to fine aggregate be leaner than one (1) to

one and one-half ($1\frac{1}{2}$). A cubic yard of concrete for wearing course in place shall contain not less than eight and one-half sacks of cement.

3. Sub-Grade.

8. Construction.—The bottom of the excavation or the top of the fill when completed shall be known as the sub-grade and shall be at all places true to the elevation as shown on the plans attached hereto.

The sub-grade shall be brought to a firm, unyielding surface by rolling the entire area with a self-propelled roller weighing not less than five (5) nor more than ten (10) tons, and all portions of the surface of the sub-grade which are inaccessible to the roller shall be thoroly tamped with a hand tamp weighing not less than fifty (50) lb., the face of which shall not exceed one hundred (100) sq. in. in area. All soft, spongy or yielding spots and all vegetable or other perishable matter shall be entirely removed and the space refilled with suitable material.

When considered necessary or of assistance in producing a compact, solid surface, the sub-grade before being rolled shall be well sprinkled with water.

When the concrete pavement is to be constructed over an old pavement composed of gravel or macadam, the latter shall be entirely loosened and the material spread for the full width of the pavement and rolled. All interstices shall be filled with fine material and rolled to make a dense, tight surface of the roadbed.

9. Acceptance.—No concrete shall be deposited until the sub-grade is checked and accepted by the engineer.

4. Forms.

10. Materials.—Where forms are required, they shall be free from warp, of sufficient strength to resist springing out of shape; wooden forms shall not be less than two (2) in. stock.

11. Setting.—The forms shall be well staked or otherwise held to the established line and grades. Where the curb is to be constructed integrally with the pavement, the upper edge of the side forms shall conform to the top of the curb.

12. Treatment.—All mortar and dirt shall be removed from the forms that have previously been used.

13. Precautions shall be taken to prevent leaks thru side forms that would allow the cement or mortar to be carried out of the coarser aggregate along the edges of the roadway.

5. Measuring Materials and Mixing Concrete.

14. Measuring Materials.—The method of measuring the materials for the concrete, including water, shall be one which will insure separate and uniform proportions of each of the materials at all times. A bag of Portland cement (94 lbs. net) shall be considered one (1) cu. ft.

15. Mixing.—The materials shall be mixed in a batch mixer of approved type and mixing shall continue after all materials are in the drum for at least one (1) minute at a minimum speed of twelve (12) revolutions per minute. The drum shall be completely emptied before receiving materials for successive batches.

16. Re-Tempering.—Re-tempering of mortar or concrete which has partially hardened, that is, re-mixing with or without additional materials or water, shall not be permitted.

6. Placing Concrete.

Concrete for Base.

17. The concrete shall be mixed with the proper proportions, determined as herein specified, of coarse aggregate, fine aggregate, cement and water.

18. Immediately prior to placing the concrete, the sub-grade shall be brought to an even surface. The surface of the sub-grade shall be thoroly wet, but shall show no pools of water when the concrete is placed.

After mixing, the concrete shall be deposited rapidly upon the sub-grade to the required depth and for the entire width of the pavement in successive batches and in a continuous operation without the use of intermediate forms or bulkheads between expansion joints.

The concrete shall be brought to an even surface, the thickness of the wearing course, below the established grade of the pavement. Workmen shall not be allowed to walk on the freshly laid concrete, and if sand or dust collects on the base, it shall be removed before the wearing course is applied. The reinforcing metal shall be placed upon and slightly pressed into the concrete base immediately after it is placed.

In case of a breakdown, concrete shall be mixed by hand to complete the section or an intermediate transverse joint placed at the point of stopping work. Any concrete in excess of that needed to complete a section at the stopping of work shall not be used in the work.

7. Concrete for the Wearing Course.

19. Mixture No. 1.—The concrete for the wearing course shall be mixed in the manner and of the proportions hereinbefore described, using for the coarse aggregate No. 1 aggregate for the wearing course hereinbefore specified.

20. Mixture No. 2.—The concrete for the wearing course shall be mixed in the manner and of the proportions hereinbefore described, using for the coarse aggregate No. 2 aggregate for the wearing course, herein specified.

21. Placing.—The wearing course shall be placed immediately after mixing, and in no case shall more than forty-five (45) minutes elapse between the time that the concrete for the base has been mixed and the time the wearing course is placed.

22. Finishing.—The wearing course shall be struck off for the entire width of the pavement and from back to back of integral curbs when used, by means of a template or strike board. Any holes left by removing any material or device used in constructing the joint shall be immediately filled with mortar composed of one (1) part of cement and two (2) parts of fine aggregate. Concrete adjoining metal protection plates at transverse joints shall be dense in character, and shall be given a smooth finish with a steel trowel for a distance of six (6) in. on each side of the joints.

After being brought to the established grade with the template or strikeboard, the concrete shall be finished from a suitable bridge, no part of which shall come in contact with the concrete. If approved by the engineer, the contractor may use a mechanical striking and finishing machine. The concrete shall be finished with a

wood float in a manner to thoroly compact it and produce a surface free from depressions or inequalities of any kind. The finished surface of the pavement shall not vary more than one-quarter (¼″) in. from the true shape.

8. Protection.

23. Curing and Protection.—Excepting as hereinafter specified, the surface of the pavement shall be sprayed with water as soon as the concrete is sufficiently hardened to prevent pitting, and shall be kept wet until an earth or other approved covering is placed. As soon as it can be done without damaging the concrete, the surface of the pavement shall be covered with not less than two (2) in. of earth or other material approved by the engineer, which cover shall be kept wet for at least ten (10) days. When deemed necessary or advisable by the engineer, freshly laid concrete shall be protected by canvas until such covering can be placed.

Under the most favorable conditions for hardening in hot weather, the pavement shall be closed to traffic for at least fourteen (14) days and in cool weather for an additional time, to be determined by the engineer.

At the season of the year when the average temperature is below 50 degrees Fahrenheit, sprinkling and covering of the pavement may be omitted at the direction of the engineer.

The contractor shall erect and maintain suitable barriers to protect concrete from traffic and any part of the pavement damaged from traffic or other causes, occuring prior to its official acceptance, shall be repaired or replaced by the contractor at his expense, in a manner satisfactory to the engineer. Before the pavement is thrown open to traffic the covering shall be removed and disposed of as directed by the engineer.

24. Temperature Below 35 Degrees Fahrenheit.—Concrete shall not be mixed or deposited when the temperature is below freezing.

If at any time during the progress of the work the temperature is or, in the opinion of the engineer will within twenty-four (24) hours drop to thirty-five (35) degrees Fahrenheit, the water and aggregates shall be heated, and precautions taken to protect the work from freezing for at least ten (10) days. In no case shall concrete be deposited upon a frozen sub-grade.

DISCUSSION.

MR. CUMMIN: I personally feel that the treatment of reinforcement and expansion joints of concrete pavement in a foot note is not entirely adequate, and I would suggest that a proper paragraph or section heading be put in on reinforcement and one for the expansion joints, putting under them practically what is said in the foot note, so that any man in going over the specifications will be sure to see that we have not forgotten that actual reinforcement and expansion joints are necessary in concrete pavement.

MR. SHERRERD: Mr. Chairman, the general committee felt that if such additional reinforcement might be desirable in any case, in order to put it in as a part of the specification, the specification should go more into detail than is here done in the foot note as to just how it should be used, and felt it was safer, at this time at least, to use it only as a foot note rather than as a part of the specification.

MR. STERN: The term "expansion joint" I believe is used in the specification. I want to submit for your consideration the changing of the term from expansion to contraction joint. It shrinks, and therefore it is really a shrinkage joint; when it does shrink, it should shrink on a straight joint rather than a jagged line. This is an important question.

MR. CUMMIN: In a great many cases the contraction is of much greater importance than the expansion. Expansion does take place in concrete sidewalks, and it does take place in concrete streets. One of the greatest troubles, of course, is the contraction.

MR. KINNEY: (by letter) I have had the pleasure of going over the report of the Sub-Committee on Concrete Paving, of the American Society of Municipal Improvements and wish to congratulate the Society on having made a marked advance along this line, as the specifications adopted this year are certainly a great improvement over the specifications for concrete paving previously adopted by the organization.

There are, however, a few paragraphs which do not represent, in our opinion, the best practice and there are several paragraphs which have been omitted, either purposely or because of the haste with which this material was prepared at Dayton. We cannot help but

feel that the wisest policy would be for the American Society of Municipal Improvements to adopt the Specifications for Concrete Roads, Pavements and Alleys, of the American Concrete Institute. These specifications are almost universally used and are giving satisfactory results. Conditions will certainly vary in different localities which will necessitate minor changes and no specification can be prepared which will be perfect for all places of use. Therefore, a specification which is used quite generally and embodies the most up-to-date practice can well be adopted by all societies, thus standardizing practice and making it possible for the methods in use by the various contractors doing this work to be standardized.

We wish to call your attention particularly to some of the paragraphs which have been omitted and which we consider to be essential to a good specification for this class of work.

In connection with the selection of the fine and coarse aggregate for a particular job, it is advisable to insist that a sample of the material proposed for use be submitted to the engineer and that subsequent deliveries be of the same quality as the sample delivered. To cover this, we would suggest the insertion of the following clause:

"Before delivery on the job, the contractor shall submit to the engineer a fifty (50) pound sample of each of the fine and coarse aggregates proposed for use. These samples shall be tested and if found to pass the requirements of the specifications similar material shall be considered as acceptable for the work. All aggregates used shall meet these specifications. In no case shall aggregates containing frost or lumps of frozen material be used."

We are also of the opinion that a paragraph which specifically prohibits the use of crusher-run stone and bank-run gravel should be included, and the following is suggested:

"Crusher-run stone, bank-run gravel or artificially prepared mixtures of fine and coarse aggregate shall not be used."

We also suggest a specification providing for the character of water to be used and offer the following:

"Water shall be clean, free from oil, acid, alkali, or vegetable matter."

The most serious criticism which we have to offer is on those paragraphs dealing with the matter of proportions. The old practice of specifying the proportions to be used by determining the voids

and allowing for a certain excess while having considerable merit from the theoretical standpoint, did not work out practically, and, therefore, was discarded some years ago by those who had made a careful study of the subject. There is no doubt that concrete mixed in the proportions of 1 part cement, 2 parts fine aggregate up to ¼ inch, and 3 parts coarse aggregate, ranging in size from ¼ to 1½ inches gives a satisfactory wearing surface under general conditions. Materials submitted for this class of work do not vary to any great extent as to percentage of voids, provided they meet the other requirements of the specifications. At least the variation is not sufficient to in any way act as a detriment to the success of the pavement. What is the necessity, therefore, of entering into a careful and exhaustive study of the voids in fine and coarse aggregate, calculating this all down in a very fine way, only to find that the proportions obtained by this method are leaner than they should be to give satisfactory results?

Experience teaches us that mixtures much leaner than 1:2:3 do not give satisfactory road surfaces. Some engineers are using 1:2:3½ and one prominent engineer is using a 1:2:4 mixture, but in obtaining this 1:2:4 mixture, he measures everything accurately in cubic foot boxes and uses two grades of coarse aggregate carefully proportioned. On the average job it is unsafe to use much leaner than a 1:2:3 mixture. Why not, therefore, give the engineer who is looking for information, the information that he wants; namely what proportions to use for this class of work?

We have tried the void determination method of proportioning, having recommended it as far back as 1908 for sidewalk work. We found that it was impractical and therefore abandoned it. An example will clearly demonstrate the ineffectiveness of this method.

Assume 33 per cent voids for the fine aggregate and 40 per cent voids for the coarse aggregate.

Ratio of cement to sand without adding excess 1:3
Ratio of cement to sand with 5 per cent excess 1:2.6
Ratio of cement to sand with 10 per cent excess 1:2.3
Ratio of mortar to coarse aggregate without excess 1:2.5
Ratio of mortar to coarse aggregate with 5 per cent excess 1:2.2
Ratio of mortar to coarse aggregate with 10 per cent excess 1:2

Assuming to simplify calculations, a 1:2½ cement-sand mortar which makes, according to tables in Taylor and Thompson 2.47 cubic feet, the proportions for 5 per cent excess mortar become 1 part cement, 2½ parts fine aggregate, and 5.43 parts coarse aggregate, for 10 per cent excess, 1 part cement, 2½ parts fine agrregate and 4.94 parts coarse aggregate. These proportions would correspond to the practical proportions of 1:2½:5½ and 1:2½:5, which proportions we know to be unsuited to the wear to which road surfaces are subjected. This method of determination has so many variables that there is room for considerable argument between the engineer and the contractor.

Why resurrect this old method and not substitute it for something which we know is right? Paragraphs 4, 5 and 6 might as well be omitted and the paragraph added by the General Committee substituted therefor.

In the two-course specifications, under the heading of coarse aggregate, we note a coefficient of wear requirement of 12. This is the same requirement as that given for one-course work. It, of course, is the assumption in using a two-course pavement, that the material to be used for the base is not satisfactory for the wearing surface. In view of this fact there is no particular necessity for a coefficient of wear requirement. The same remarks regarding proportioning in the one-course specifications may be applied to the corresponding paragraphs in the two-course specifications.

We understand that the committee purposely omitted specifications for both joints and reinforcement, feeling that there should be the freest opportunity among engineers to study their particular requirements and use whatever method of construction seemed to be best suited to local conditions. It would seem to us that the function of a society, such as the American Society of Municipal Improvements, should be to furnish the engineer details of the best practice or practices in vogue. If the engineer desires to alter the specifications covering any particular feature of the work, he is certainly privileged to do so.

We sincerely hope that the committee will see fit in future work along this line to consider the subject of both joints and reinforcement. We recommend the following paragraphs in this connection:

*Protected Joints.** The concrete at all transverse joints shall be protected with joint protection plates which shall be rigidly anchored. to the concrete. The upper edges of the plates shall be even with each other and the adjoining surface of the concrete. All steel plates varying more than one-quarter (¼) inch from the finished surface of the concrete, as shown on the plans attached hereto, shall be ground to meet the specified requirements, or slabs in which such plates occur shall be removed and replaced with new material by the contractor at his expense."

"*Unprotected Joints.** All transverse joints shall extend thru the entire thickness of the pavement and the filler shall project not less than one-half (½) inch above the finished surface. The concrete adjacent to these joints shall be finished with a wood float, which is divided thru the center and which will permit finishing on both sides of the filler at the same time. Before the pavement is opened to traffic, joint filler shall be cut off to a height of one-quarter (¼) inch above the surface of the pavement."

"*Reinforcing.* Concrete pavements twenty (20) feet or more in width shall be reinforced. The cross-sectional area of the reinforcing metal running parallel to the center line of the pavement shall amount to at least 0.038 square inch per foot and the cross-sectional area of reinforcing metal, which is perpendicular to the center line of the pavement, shall amount to at least 0.049 square inch per foot. The reinforcement shall weigh not less than 25 pounds per 100 square feet.

Reinforcing metal shall not be placed less than two (2) inches from the finished surface of the pavement and otherwise shall be placed as shown on the drawings attached hereto. The reinforcing metal shall extend to within two (2) inches of all joints but shall not cross them. Adjacent widths of fabric shall be lapped not less than four (4) inches when the lap is made perpendicular to the center line of the pavement and not less than one (1) foot when the lap is made parallel to the center line of the pavement."

We strongly urge upon the Committee on Concrete Paving, a consideration of the foregoing, during the coming year when the new specifications of the Society are in preparation.

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*NOTE: When the specification "Protected Joints" is to be used. "Unprotected Joints" should be omitted. and vice versa.

MINORITY REPORT OF SUB-COMMITTEE ON BITUMINOUS CONCRETE PAVING SPECIFICATIONS.

Your sub-committee on Bituminous Concrete Paving Specifications acting under instructions received at the Boston meeting of the Society held in October, 1914, has prepared the following specifications for bituminous concrete pavements which your Committee believes provides for a pavement coming within the limits of good practice and which does not infringe any patent that has been issued for pavements of this class. The specifications have been discussed with the president of the Warren Brothers Company and are agreed to by him as not being an infringement of any of the patents held by his company. As agreed with the Warren Brothers Company and in accordance with instructions of this Society there is also submitted as part of the report of your sub-committee, the Warren Brothers standard specifications for bitulithic pavement.

It is our understanding that the term Bituminous Concrete is properly applied to any mixture suitable for paving purposes composed of broken stone, sand (or other fine mineral matter) and bituminous cement, mixed together before being laid, and which is laid while in a plastic condition. To this description, to be consistent with the definition of Bituminous Concrete adopted by the Society, should be added "there must be stone enough in its composition to form an important part thereof and add to its strength and durability."

The following specifications have been drawn up in accordance with this definition.

It is our belief that bituminous concrete may be successfully used as a paving material under a great variety of conditions and traffic; that it is adapted to use on a standard concrete base and on a well constructed macadam base, either new or old, and therefore finds an especial field in providing a permanent wearing surface for old macadam.

In the preparation of these specifications we have endeavored to recommend only methods, proportions and materials that have been tried and proved successful under a variety of conditions. For this

reason only the bituminous cements have been considered that retain approximately their original consistency after going thru the process of mixing and laying and are permanent in quality thereafter, excluding from consideration in this connection emulsions, oils volatile in character, and cements softened with light fluxes so that they may be worked cold or at low temperatures. Thus the cements specified are practically solid at ordinary atmospheric temperatures and require to be heated and mixed with the stone and sand while they are hot. The processes specified require the use of standard machinery in which the bituminous cement is not exposed directly to the action of fire during the process of mixing.

In these particulars we have endeavored to be conservative, believing there is danger in offering anything but tried and proved materials and methods in a standard specification.

We do not consider that the following specifications should be used in their entirety exactly as written in any case, as the effort has been made to produce specifications general in character which may be adapted to varying conditions of traffic. Thus the extreme range of penetration for asphaltic cement has been made from 40 to 85, which is too wide a range to admit for any particular case. A penetration of 40 will give a hard and stable pavement, while 85 will give a pavement too soft for heavily traveled streets. The choice should be made to meet conditions and the specifications applying to any particular case drawn closer within the limits named for penetration, working temperatures, etc. The engineer in charge should secure complete reliable analyses of the bituminous cements he contemplates using from chemists making a specialty of bituminous products and compare them on all important points, not considering the same necessarily satisfactory because the results come within the extreme limits specified.

Asphaltic cements made from both natural and manufactured asphalts come within the requirements of the following specifications.

Respectfully submitted as a minority report of the sub-committee, by

E. A. KINGSLEY.

The majority report of the committee and the discussion will be found on page 522.

SPECIFICATIONS FOR BITUMINOUS CONCRETE PAVEMENT.

Adopted October 14, 1915.

These specifications will be modified from time to time to keep them fully up to date. Suggestions as to modifications or additions are solicited and should be sent to the Secretary, or to Linn White, South Park Commission, Chicago, Ill., Chairman of the Sub-Committee on Specifications for Bituminous Paving, and George W. Tillson, Boro Hall, Brooklyn, New York, Chairman of General Committee on Standard Specifications.

Sub-Grade.

The contractor will be required to do all of the grading necessary to bring the surface to the proper sub-grade as determined by the lines and grades given by the engineer. If the material at sub-grade is of an unstable character and unfit for foundation, the contractor shall make such additional excavation as may be determined by the engineer and refilled with approved material. After all necessary grading has been done to bring this surface to sub-grade, the street shall be thoroly rolled with an approved road roller weighing not less than ten tons. If settlement occurs the depressions shall be filled and then re-rolled until the surface is solid, uniform and parallel with the grade and cross-section of the finished pavement. All filling shall be free from animal or vegetable matter and of a character approved by the engineer. In cases of spongy or yielding sub-grade some other means besides ordinary rolling and sprinkling must be employed to obtain satisfactory compaction of the sub-grade. In the case of loose, sandy soils, a small amount of cinders, gravel or fine crushed stone spread over the surface will often put it in a condition to be compacted under the roller. In the case of clay soils that puddle up and wave or creep under continued rolling, it is best to roll as dry as possible and to be sparing in the use of water when rolling the first layer of macadam. Cinders, gravel or stone screenings will often help in rolling such sub-grades.

Sub-Drainage.

When the soil is of such a character that it retains an excessive amount of moisture, such as clay, subject to swelling or heaving under the action of frost, or sands similar to quicksand that do not afford a ready natural drainage, sub-drains should be provided.

These may be of two general kinds; first, tile drains of open porous material of vitrified tile laid with open joints; second, trenches filled with broken stone, gravel, cinders or other similar material.

In some cases it may be sufficient to construct a sub-drain on each side of the roadway at or near the lines of the gutters, but when the soil is of a very wet nature it may be advisable to lay additional lines of drains which may be in or near the middle of the roadway. This system of drains may be varied by diagonal lines of drains running from near the crown of the roadway to the gutters.

In all cases the drains should have connections with the existing sewers, catch basins or inlets.

New Macadam Foundation.

If the pavement is to be laid on a new macadam foundation or base, the latter shall be built as follows:

The total thickness of the macadam base will vary according to character of soil, drainage, kind of stone available, etc. In general, the macadam base should be constructed of broken stone which is sound, hard and durable under traffic. The broken stone should be separated into different sizes by screening, the smaller sizes with the dust, being used to fill and bond together the larger sizes. The thickness of the base should be regulated by experience in constructing ordinary water-bound macadam roads in similar situations, the total thickness of pavement, including wearing surface, being made the same or a little less than well constructed macadam.

After the sub-grade has been carefully prepared, spread a layer of clean stone passing a three (3) to three and one-half (3½) inch revolving screen and held on a two (2) inch screen to a depth sufficient when thoroly rolled to form about two-thirds (2/3) of the total thickness of the base. The thickness of this layer should be regulated by laying on the sub-grade at proper intervals, cubical blocks of wood of the proper dimensions to give the desired thickness. Over this layer of stone, spread with shovels stone screenings in sufficient quantity to fill the voids between the larger stone. The screenings should be spread gradually and thoroly rolled with a road roller weighing at least 10 tons during the process of spreading the screenings. As the screenings are worked into the coarse stone under the roller, more should be added here and there where voids

appear. At first the rolling should be done dry until the stone appears to be well filled, then the surface should be well sprinkled and again rolled, the rolling and sprinkling continued until the layer of stone is thoroly compacted and no more screenings can be forced in. Just enough screenings shall be used to fill and bond the stone leaving no surplus screenings on the top.

The above method may be varied by using the crusher run of stone without the addition of any other filler where the small sizes are not in excess. Also a filler other than stone screenings, such as bank gravel or sand, may be used in some cases where experience with materials available shows better results can be obtained. Under some conditions the character of soil and stone available may be such as not to require the use of any filler with the stone of the first course. The specifications given, however, represent the best average practice where stone with bonding value, such as limestone or trap rock, can be obtained.

When the first layer of macadam is completed as specified, spread a second layer of clean stone passing a two (2) or two and one-half (2½) inch screen and held on a one (1) inch screen to a depth sufficient when thoroly rolled to form the remaining one third of the total thickness of the base. Over this layer of stone spread evenly with shovels stone screenings and roll with the application of water by sprinkling. The sprinkling and rolling shall be continued until the stone is well bonded and until no more compression can be observed under the roller. Just enough filler should be used to accomplish this purpose and not enough to form a layer or film over the surface of the stone. It is better not to fill the stone quite flush, leaving the coarse particles of stone slightly projecting, so as to have a coarse, grainy base upon which to put the wearing surface.

As an alternate method of construction the macadam may be well filled with screenings, watered and rolled until flush up smooth. Over the surface of the macadam base thus constructed shall be spread a layer of clean stone of a size to pass a two (2) inch ring and be retained on a one (1) inch ring. This layer of stone shall average one and one-half (1½) inches or practically only one stone deep and is for the purpose of forming a binder or key between the base and wearing surface and thus preventing lateral displacement of the surface. After being spread evenly it shall be lightly rolled

only enough to partially imbed the stone and set them firmly in place without crushing or forcing the fine material up from below to fill the surface voids. The final rolling should be done while the macadam base is still moist and comparatively soft.

The thickness of the pavement, including base and wearing surface, should vary according to local conditions and should be fixed by the engineer in charge when all the varying conditions of soil, drainage, traffic and materials of construction are understood. In general, a thickness of macadam base of eight (8) inches with a wearing surface of two inches will be enough for any except the most adverse conditions, and a base of four to four and one-half (4½) inches with a wearing surface of from one and one-half (1½) to two (2) inches will meet the most favorable conditions of firm, unyielding soils and light traffic.

Old Macadam Foundation.

If the pavement is to be laid on an old macadam foundation, the surface shall be thoroly swept and cleaned of all fine material that may be caked upon the surface of the stone or lying loose as dust, thereby exposing the clean, coarse stone for the reception of the bituminous concrete.

If the old macadam does not present the desired coarse, grainy surface, or is not at proper and satisfactory grade after cleaning, it shall be spiked up and redressed to the desired crown and grade, the coarse stone being brought to the top by harrowing or otherwise, or new stone added where needed. It shall then be watered and rolled until thoroly compacted. If the result is not the required coarse, grainy surface, a layer of clean stone shall be spread and lightly rolled as described above in the paragraph relating to new macadam foundation.

Concrete Foundation.

When a portland cement concrete foundation is used, it should be laid according to the standard specifications adopted for concrete foundation. The surface, however, should be roughened to form a key for the wearing surface. This may be done by using coarse stone of fairly uniform size and laying the concrete fairly wet, or by brooming, washing with a hose before hard set, tamping with grooved rammers, or by spreading a light layer of coarse, clean stone over the fresh concrete and lightly tamping.

Curb.

If a curb or curb and gutter is used, the face against which the paving material will be laid shall be painted with a coat of hot bituminous cement in advance of the pavement.

A curb or curb and gutter should be used in all cases of a street devoted to miscellaneous uses and where there is occasion for many vehicles to stop at the curb line, but in the case of a park driveway or a suburban highway, a bituminous concrete pavement may be successfully used without a curb. No other protection for the edge of the pavement is required except to provide a coarse, grainy base into which the paving material is rolled.

Wearing Surface.

On the foundation, as heretofore specified, shall be laid the bituminous concrete wearing surface, which shall consist of a mineral aggregate mixed with bituminous cement and laid as hereinafter specified.

This wearing surface shall have a thickness of .. inches after thoro compression with a roller.

For heavy traffic a thickness of two (2) inches is sufficient for all practical purposes and in some cases will afford more stability than a greater thickness.

For moderate and light traffic one and one-half ($1\frac{1}{2}$) inches will be sufficient thickness for the wearing surface when laid on a well constructed base as specified above.

Mineral Aggregate.

The mineral aggregate shall consist of a mixture of broken stone and sand, to which shall be added as required, stone, dust or portland cement.

Any sound, durable stone, either trap rock, limestone or granite, usually considered suitable for macadam, may be used. It should be broken as nearly cubical as practicable. It should not show distinct planes of cleavage or crystalline faces and should not readily crush or split under the roller when being rolled in the pavement. Between two kinds of stone, choice should generally be made of

the one showing the greater toughness rather than hardness. A certain percentage of absorption, such as is shown by the better grades of limestone, is a desirable quality, as the bonding strength of the cement is somewhat improved thereby.

The sand shall be hard-grained, moderately sharp, free from loam or other foreign material and varying in size from that passing a one-quarter (¼) inch screen to dust passing a two hundred-mesh screen, and there should not be over twenty per cent held on the ten-mesh screen.

Dust in the form of finely ground limestone or portland cement may be added to the mixture, but in such quantities that the screenings of the total ingredients entering into the mix shall in no case show over eleven (11) per cent by weight passing a 200-mesh screen.

The proportions of the various ingredients composing the Bituminous Concrete shall be as follows:

Passing 200 Mesh Screen,		7-10 per cent.
Passing 80 Mesh Screen, but retained on a	200,	10-20 per cent.
Passing 40 Mesh Screen, but retained on an	80,	10-25 per cent.
Passing 20 Mesh Screen, but retained on a	40,	10-25 per cent.
Passing 8 Mesh Screen, but retained on a	20,	10-20 per cent.
Passing 4 Mesh Screen, but retained on an	8,	15-20 per cent.
Passing 2 Mesh Screen, but retained on a	4,	5-10 per cent.

The minimum amount of bitumen allowed shall only be used in mixtures containing the minimum total passing the 80-mesh. The percentage of bitumen must be increased above the minimum as the total passing the 80-mesh increases.

The item designated as Dust includes in addition to the portland cement or stone dust that may be added, fine sand passing a 200-mesh screen not exceeding 5 per cent of the total mixture and such 200-mesh mineral dust self-contained in the refined asphalt.

Method of Mixing.

The aggregate shall be dried and heated in properly designated driers before mixing with the bituminous cement. The driers shall be of the revolving type, thoroly agitating and turning the materials during the process of drying. When the aggregate is thoroly dried

and heated to a temperature of from 200 to 350 degrees F., depending upon the bituminous cement used, it shall be immediately before cooling or exposure to moisture, mixed with the hot bituminous cement as hereinafter specified. If stone dust is used, it shall be introduced directly into the mixer without passing thru the drier.

The bituminous cement shall be melted in a tank arranged so the heat can be properly and easily controlled and regulated. When melted and raised to a temperature of from 200 to 350 degrees F., depending on the bituminous cement used, it shall be combined in the proper proportions with the hot aggregate and immediately mixed in a properly designed mixer with revolving blades until a thoro and intimate mixture of the ingredients has been accomplished and the particles composing the aggregate are evenly and thoroly coated with the bituminous cement. The mixer shall not be exposed directly to the action of fire.

Method of Laying.

While still hot from the mixer, the paving mixture shall be spread evenly on the foundation with hot iron rakes and shovels, so that when compressed with the roller it shall have the thickness specified, with the surface even and true to grade. Along the curb and around manholes, catch basins and other obstructions in the street, where the roller cannot reach, the compression shall be secured by the use of hot iron tampers. The rolling and tamping shall be done as quickly as possible after the material is spread, while still hot and pliable. When the paving mixture is hauled on the street in dump wagons it shall be, when ordered by the engineer, kept covered with canvas to retain heat, dumped on platforms and shoveled into place and raked to the proper grade. As soon as spread the paving mixture shall be rolled with a tandem roller weighing at least six (6) tons and the rolling continued, working lengthwise and diagonally of the street. When practicable, additional compression in the wearing surface should be secured by the use of a ten-ton roller. Rolling must be steadily kept up and continued until all roller marks shall disappear and the surface gives indications of no further compressibility.

The paving shall be done continuously, so the number of joints between the hot and cold material may be reduced to the minimum. When it is not practicable to lay it continuously and a joint is

unavoidable, the edge of the cold material shall be trimmed down to a rough feather edge, and the surface, where the joint is to be made, painted over with bituminous cement, the hot material raked over the feathered edge and thoroly rolled. Instead of trimming the cold material, joint strips may be used consisting of strips of canvas about eighteen (18) inches wide with three parallel lines of three-quarter (¾) inch ropes sewed on the under side about three (3) inches apart. The joint strips shall be laid on the feather edge of the freshly raked material with the upper rope at the line where the thickness begins to decrease and the rolling completed on top of the canvas as for finished pavement. The faces of the curb and gutter, iron castings, etc., shall be painted with bituminous cement before the paving mixture is laid.

Surface Finish.

As soon as possible after the rolling of the mixture is finished, and while the surface is still fresh and clean, and, if possible, while warm, a seal coat of bituminous cement of properly consistency to be flexible when cold shall be spread over the surface. It shall be applied while at a temperature of from 200 degrees to 350 degrees F., depending upon the bituminous cement used, and evenly spread with rubber squeegees or mops. Only a sufficient coat shall be spread to flush the surface voids without leaving an excess. Immediately over this, a top dressing of torpedo sand, fine gravel or stone chips free from dust, which must be thoroly dry and heated in cold weather, shall be spread and thoroly rolled into the surface. A small surplus shall be left to be worn in or worn away by the traffic.

In the case of park drives and roadways not subjected to heavy, constant traffic, and where a more grainy and coarse surface is desired, the surface finish specified above may be omitted and the following method of finishing adopted:

As the bituminous concrete is raked to grade, and just before the roller comes on it, spread dry stone chips or coarse torpedo sand, evenly with swinging motions of a shovel, until the surface is barely covered. Then roll thoroly as specified in the preceding paragraph relating to method of laying. If bare spots appear under the roller, sprinkle more chips or sand and continue the rolling until the whole surface is fairly covered.

After the sand or stone chips have worn into the surface the street shall be swept, all excess of surfacing material removed and the street left clean.

Asphaltic Cement.

The asphaltic cement may be prepared from the following asphalts combined with flux as hereinafter specified, if flux is necessary: (1) From refined natural asphalt; (2) from the residue obtained in the careful distillation either with or without oxidation of asphaltic or semi-asphaltic petroleum; (3) from any uniform combination of the preceding materials together with a suitable flux, if flux be necessary, such combination being subject to the approval of the engineer.

Each bidder must state the nature and origin of the bitumen to be used by him and further, shall submit samples of the bituminous cement with his proposal.

The asphaltic cement shall pass the requirements designated below:

(1) It shall have a penetration of from 40 to 85 at 77 degrees F., depending upon the traffic and climatic conditions and hardness of the pavement desired. A penetration of from 40 to 50 in most cements will produce a hard, exceedingly stable pavement which should be used on streets subjected to constant or heavy traffic.

A penetration of from 50 to 65 in most cements will produce a pavement best calculated to meet general traffic conditions. The above penetrations are measured in hundredths centimeters with a No. 2 needle weighted with one hundred grams acting for five (5) seconds.

(2) When 50 grams of the cement are maintained at a temperature of 325 degrees F., for five hours in a tin box 2¼ inches in diameter by 1¾ inches deep, there must not be volatilization of more than 5 per cent by weight of the bitumen present, nor shall the original penetration be reduced thereby over one-half.

The method of test employed is that recommended by the Committee on Coal Analysis of the American Chemical Society.

(3) Of the bitumen of the asphaltic cement which is soluble in carbon disulphide, 98½ per cent shall be soluble in carbon tetrachloride. In this test for carbenes, the asphaltic cement to be tested

should be allowed to stand over night, covered wtih purified carbon tetrachloride. The test to be performed in subdued light.

(4) The cement shall not flash at a less temperature than 350 degrees F., New York State Closed Oil Tester.

Flux.

Use the flux specifications prepared by the Committee on Asphalt Pavement Specifications.

Coal Tar Cement.

The coal tar cement shall be residue of the distillation of coal tar only, and shall be refined for the special purpose of making a paving cement.

No mixture of hard pitch with the lighter oils of coal tar will be permitted.

Its specific gravity shall be not less than 1.20 nor more than 1.29 at 69 degrees F.

The melting point determined by the cube method shall be not less than 100 degrees F., and not more than 115 degrees F.

It shall contain not less than 15 per cent, nor more than 30 per cent of free carbon insoluble in benzol.

It shall be free from water as determined by distillation and shall show upon ignition not more than ½ per cent of inorganic matter.

No distillate shall be obtained lower than 338 degrees F., and up to 600 degrees not less than 5 per cent and not more than 20 per cent of distillate shall be obtained. The distillate shall be of a gravity of not less than 1.03 at 60 degrees F. The residue shall have a melting point of not more than 165 degrees F. In making this distillation an 8-ounce glass retort shall be used and the thermometer suspended so that before applying the heat the bulb of the thermometer is one-half inch above the surface of the liquid. The melting point of the pitch shall be determined by suspending a ½-inch cube in a beaker of water one inch above the bottom. The temperature shall be raised 9 degrees per minute from 60 degrees F. The temperature recorded the instant the pitch touches the bottom shall be considered the melting point of the pitch. In testing the original materials the initial temperature shall be 40 degrees F.

Water Gas Tar Cement.

1. The specific gravity at 25 degrees C. shall be between 1.155 and 1.170.

2. On extraction with cold carbon disulphide at room temperature for 20 minutes, not less than 97½ per cent shall be soluble.

3. When tested in a penetrometer at 25 degrees C. with a No. 2 needle under 100 grams load for 5 seconds, it shall have a penetration of not less than 27.5 m.m. and not more than 32.5 m.m.

4. When 100 c.m. are distill in a 250 c.c. Engler flask according to the method proposed by the American Society for Testing Materials, the loss by weight shall be within the following limits:

From Start to 170 degrees C.	0
170 to 225 degrees C.	not over ½%
225 to 270 degrees C.	from 2 to 6%
270 to 300 degrees C.	from 5 to 9%
Residue	not less than 84%

SPECIFICATIONS FOR BITULITHIC PAVEMENT ON ANY APPROVED FORM OF FOUNDATION.

Wearing Surface.

On the foundation prepared as herein above specified, shall be laid the Bitulithic Wearing Surface and Seal Coat, described below, so as to have a thickness of two (2) inches after thoro compression. The Wearing Surface shall be composed of hard crushed stone, sand, and Bitulithic Cement.

The Bitulithic Cement herein specified besides being produced under the direction, processes, supervision and laboratory inspection of, and with ingredients approved by Warren Brothers Company, shall in all respects comply with the specifications for Asphalt Cement contained in the sheet Asphalt Specifications of the American Society of Municipal Improvements.

Either of the two following methods and apparatus shall be used in the preparation of the wearing surface.

1. The stone and sand shall be heated in a rotary dryer and while still hot separated into the desired number of different sizes

by means of a rotary screen having a minimum screen opening of about 1/10 of an inch and a maximum opening of about 1½ inch. The openings in the successive screen sections up to one-half inch (½″) size, shall not vary more than one-fourth of an inch (¼″) and not more than three quarters of an inch (¾″) for the sizes larger than one-half inch (½″). The aggregate thus separated shall pass into a bin having sections or compartments corresponding to the screen sections. From these compartments the aggregate shall pass into a weigh box, resting on a multi-beam scale. The desired amount of aggregates from each of the above compartments, shall be accurately weighed separately on the scale and the batch dropped into a "twin pug" mixer, where it shall be intimately associated and thoroly commingled with a predetermined quantity of Bitulithic Cement sufficient to coat all particles of the aggregate and to fill the voids in same.

2. The stone and sand shall first be carefully measured as to sizes and a definite quantity of each size shall then be fed into an elevator terminating in a hopper or bin which discharges into a rotary dryer or heater, both hopper and heater being so designed as to keep each batch by itself until heated. From the rotary heater the batch of mineral aggregate shall pass into a rotary cylindrical mixer containing blades, spirals or other devices for producing a uniform mixture of the mineral aggregate with a predetermined quantity of the Bitulithic Cement sufficient to coat all the particles of the aggregate and to fill the voids in same.

The different sized particles of stone and sand ranging in size from impalpable powder to about one-half the thickness of the wearing surface, shall be combined in such proportions as to secure in the mineral aggregate density, or low percentage of voids, and inherent stability or resistance to displacement, producing an aggregate which when combined with the Bitulithic Cement and laid in place and compacted will form a street paving structure consisting of mineral aggregate of different sizes and the Bitulithic Cement which permeates the entire mass, fills the voids and unites the various particles thereof. If the crushed stone and sand do not contain enough finely divided particles, or impalpable powder to produce a low percentage of voids in the aggregate, the deficiency shall be made up by the addition of any other suitable fine mineral matter.

The mixture and ingredients thereof shall be maintained at a temperature consistent with good workmanship. The mixture when reaching the street shall be hot enough to allow of being easily spread and raked and shall not be so hot as to injure the Bitulithic Cement.

Surface Finish or Seal Coat.

There shall be spread over the Bitulithic surface mixture a seal coat, using per square yard of Bitulithic pavement approximately one-fourth (¼) gallon of Bitulithic Cement, into which shall be incorporated approximately twenty-five (25) pounds of mineral aggregate not larger than one-quarter (¼) inch diameter. After spreading the seal coat, it shall be thoroly rolled into the Bitulithic surface mixture. On grades a coarser aggregate may be used.

General.

Each layer of the work shall be kept as free as possible from dirt, so that it will unite with the succeeding layer.

The bituminous composition or cement shall in each case be free from water and shall be especially refined to remove volatile and other matter susceptible to atmospheric influences .

Warren Brothers Company, owner of the patents used in the construction of the Bitulithic Pavement, shall file with the proper official or board which is about to receive bids for the work, a properly executed binding agreement to furnish any contractor desiring to bid for the work all the necessary Bitulithic Surface material, mixed ready for use, and Bitulithic Cement, and the sand, gravel, or stone screenings for the surface finish course, in accordance with Sections, "Wearing Surface" and "Surface Finish," at a definite reasonable price per square yard. Said price shall include a license to use all of the patents required in the construction of the Bitulithic Pavement as herein specified.

The acceptance of bids by.............................. and the letting of a contract for the same shall be deemed by Warren Brothers Company to be an acceptance of its proposal by

....

and by the Contractor to whom such contract shall be awarded, and are all that shall be necessary to bind Warren Brothers Company to said agreement. The filing of a bid under these specifications will be construed as an acceptance of the terms of the license agree-

ment filed by the Warren Brothers Company, at the price fixed in said agreement, which is on file with the proper official or board.

Boston, Mass., Nov. 27th, 1915.

Mr. Chas. C. Brown, C. E., Secretary,
American Society of Municipal Improvements,
Indianapolis, Indiana.

Dear Sir:—

In accordance with our verbal statement to the Sub-Committee on Bituminous Paving Specifications, the General Committee on Paving Specifications, and subsequently on the floor of the Convention of the Society at Dayton, we hereby agree that a pavement constructed by the use of the proportions of mineral aggregate enumerated below, combined with bituminous cement, will not possess the inherent stability and density covered by the claims of and, therefore, will not infringe on our patents. The proportions referred to as adopted by the Society at the Dayton convention being as follows:

Passing	200 mesh screen	7 to 10 per cent.
Passing	80 mesh screen	10 to 20 per cent.
Passing	40 mesh screen	10 to 25 per cent.
Passing	20 mesh screen	10 to 25 per cent.
Passing	8 mesh screen	10 to 20 per cent.
Passing	4 mesh screen	15 to 20 per cent.
Passing	2 mesh screen	5 to 10 per cent.

Very truly yours,

WARREN BROTHERS COMPANY,
(Signed) By Geo. C. Warren,
President.

REPORT OF SUB-COMMITTEE ON SPECIFICATIONS FOR BROKEN STONE AND GRAVEL ROADS.

Your sub-committee on Specifications for Broken Stone and Gravel Roads herewith respectfully submits its Report covering its work during the preceding year.

We are herewith submitting in this Report, in accordance with instructions received at the 1914 Convention from the Committee on Standard Specifications, specifications for a bituminous concrete pavement having a mineral aggregate composed of one product of a stone crushing plant.

It has been the object of the committee to present in its specifications fundamental principles of construction. In accordance with instructions received at the Wilmington Convention in 1913, properties of broken stone and limitations covering the physical and chemical properties of bituminous materials have been incorporated in our specifications. It should be borne in mind that specifications covering the properties of materials and certain details of construction must be varied in many cases in order that a given form of construction may be economical and suitable for local conditions. Therefore, the specifications incorporated in our Report should serve as guides rather than standards adapatable to all conditions which may be found thruout America.

The work on the calendar of the sub-committee includes the drafting of specifications for Gravel Road, Gravel Road with Bituminous Surface, and Bituminous Gravel Pavement, and revisions, as required, of specifications heretofore submitted by the sub-committee.

Respectfully submitted,

Arthur H. Blanchard, Chairman.
T. H. Brannan.
William H. Connell.
W. W. Crosby.
Prevost Hubbard.
A. J. Lenderink.
R. A. MacGregor.
Frederic A. Reimer.

Discussion will be found on page 442.

SPECIFICATIONS FOR A BITUMINOUS CONCRETE PAVEMENT MINERAL AGGREGATE COMPOSED OF ONE PRODUCT OF A STONE CRUSHING PLANT.

Adopted October 14, 1915.

These specifications will be modified from time to time to keep them fully up to date. Suggestions as to modifications or additions are solicited and should be sent to the Secretary, or to A. H. Blanchard, Columbia University, New York City, Chairman of the Sub-Committee on Specifications for Broken Stone and Gravel Roads, and George W. Tillson, Boro Hall, Brooklyn, New York, Chairman of General Committee on Standard Specifications.

General Description. The bituminous concrete wearing course shall consist of a compact mixture of broken stone and asphalt cement or refined tar laid to conform to the required grades and cross sections, covered with a seal coat of asphalt cement and broken stone chips, and constructed as hereinafter specified.

Broken Stone.

Quality. All broken stone shall be clean, rough surfaced and sharp angled, of compact texture and uniform grain.

Tests. The broken stone shall be subjected to abrasion and toughness tests conducted by the engineer in accordance with methods adopted by the American Society for Testing Materials, August 15, 1908. The broken stone used for the construction of the wearing course shall show a loss on abrasion of not more than 3.5 per cent or a French coefficient of wear of not less than 11.5, and its toughness shall not be less than 13.0.

Broken Stone Chips. Broken stone chips shall consist of the product of a stone crushing plant obtained by passing the broken stone through a section of a rotary screen having circular openings three-eighths (3/8) or one-half (1/2) inch in diameter and over a screen having openings of one-eighth (1/8) or one-quarter (1/4) inch.

Broken Stone for Mineral Aggregate. Broken stone for the mineral aggregate of the wearing course shall consist of one product of a stone crushing and screening plant. It shall conform to the

following mechanical analysis, using laboratory screens having circular openings: All of the broken stone shall pass a one and one-quarter (1¼) inch screen; not more than ten (10) per cent nor less than one (1) per cent shall be retained upon a one (1) inch screen; not more than ten (10) per cent nor less than three (3) per cent shall pass a one-quarter (¼) inch screen.

Heating. Before entering the mixer, the broken stone for the mineral aggregate shall be heated until thoroly dry to between 66° C. (150° F.) and 121° C. (250° F.), as directed, in revolving driers in which no flame shall be permitted to come in contact with the broken stone and in which the broken stone shall be continuously agitated during the heating.

Bituminous Cement.

Asphalt Cement and Refined Tar. The asphalt cement or refined tar used in the construction of the wearing course of the bituminous concrete pavement shall conform with either one of the specifications covering the chemical and physical properties of bituminous cement included under the item entitled "Asphalt Cements and Refined Tars for Wearing Course of Bituminous Concrete Pavement." If asphalt cement is used in the bituminous concrete wearing course, the same asphalt cement shall be used for the seal cost. If refined tar is used in the bituminous concrete wearing course, an asphalt cement shall be used in the seal coat and shall conform with either one of the specifications covering the physical and chemical properties of asphalt cements included under the item entitled "Asphalt Cements for Seal Coat for Bituminous Concrete Pavement."

Previous Service. The contractor will be required to show, to the satisfaction of the engineer, that the company manufacturing the asphalt cement or refined tar he proposes to use under a given specification has, for a period of at least two years, manufactured asphalt cement or refined tar in a thoroly equipped plant, and that asphalt cement or refined tar manufactured of bituminous material obtained from a similar source to that which he proposes to use, shall have been in continuous and successful use for a period of at least two years in bituminous pavements constructed by the mixing method previous to the date of the letting in which his proposal was submitted.

Heating. The asphalt cement or refined tar shall be heated in kettles so designed as to admit of even heating of the entire mass, with an efficient and positive control of the heat at all times. Asphalt cement shall be heated as directed to a temperature between 135° C. (275° F.) and 177° C. (350° F.). All asphalt cement heated beyond 177° C. (350° F.), either before or during mixing with the broken stone, shall be rejected. Refined tar shall be heated as directed to a temperature between 93° C. (200° F.) and 135° C. (275° F.). All tar heated beyond 135° C. (275° F.), either before or during mixing with broken stone, shall be rejected. No tar shall be heated in kettles containing any asphalt cement and in like manner no asphalt cement shall be heated in kettles containing any tar. Before changing from one type of material to the other, kettles shall be scrupulously cleaned in order to avoid mixtures of the two. Any such mixtures resulting from this cause shall be rejected.

Thermometers Furnished by Contractor. The contractor shall provide a sufficient number of accurate, efficient, stationary thermometers for determining the temperatures of the asphalt cement or refined tar in kettles.

Construction of Wearing Course

Mixing. When thoroly heated to the temperature directed, the asphalt cement or refined tar and the broken stone for the bituminous concrete shall be mixed so that the resulting mixture shall contain between five (5) and eight (8) per cent by weight of bitumen, as directed, depending primarily upon the kind of bituminous cement and mineral aggregate which are used. A mixer shall be used, having revolving blades, and so designed and operated as to produce and discharge a thoroly coated and uniform mixture of non-segregated broken stone and bituminous cement. When discharged, mixtures of asphalt cement and broken stone shall have a temperature not more than 149° C. (300° F.) and not less than 93° C. (200° F.) as directed. When discharged, mixtures of refined tar and broken stone shall have a temperature not more than 121° C. (250° F.) and not less than 66° C. (150° F.).

Surface of Foundation. Before laying the bituminous concrete, the surface of the cement-concrete foundation shall be dry and thoroly cleaned. If any defective areas exist in the cement-concrete

foundation, they shall be repaired as directed at least ten (10) days in advance of laying the bituminous concrete. In cases where cement-concrete edging is not used, compacted shoulders, forming a continuation of the surface of the foundation, shall be constructed. A two (2) inch plank shall be laid on each shoulder at the edge of the foundation. These planks shall remain in place until after the seal coat has been finished.

Prevention of Dust. The shoulders of the road and adjacent grounds shall be sufficient sprinkled during the placing of bituminous material wherever there would otherwise be danger of clouds ot dust blowing over the pavement.

Laying Bituminous Concrete. The bituminous concrete, heated and prepared as specified, shall be delivered direct from the mixer to the point of deposition on the foundation in trucks or wagons, provided with canvas covers for retaining the heat. As delivered the bituminous concrete shall have a temperature of at least 66°C. (150° F.). Material having a lower temperature than this shall not be laid upon the foundation. The hot bituminous concrete shall be dumped upon platforms, constructed as directed, and shoveled with hot shovels into position on the foundation. The bituminous concrete shall be immediately uniformly spread over the foundation course by men experienced in such work and thoroly compacted by rolling. When compacted the wearing course shall have a thickness at no place of less than two (2) inches and shall be free from surface depressions and irregularities. The paving shall be done as continuously as practicable, to reduce to a minimum the number of joints between hot and cold materials. Such joints shall be constructed as directed.

Rolling. The bituminous concrete wearing course, laid as specified above, shall be rolled at once, while the mixture is warm and pliable, beginning at the edges and working toward the center. Means for preventing the bituminous material from adhering to the roller without injury to the bituminous concrete, shall be provided. Rolling shall continue without interruption until all roller marks disappear and the surface shows no further compressibility. Places which the roller cannot effectively reach shall be compacted with hot iron tampers.

Roller. Rollers used on the bituminous concrete shall be well balanced, self-propelled, tandem rollers, weighing between ten (10)

and twelve (12) tons each. Each shall have a compression under the rear roller of between two hundred and fifty (250) and three hundred and fifty (350) pounds per linear inch of roll, and shall be provided with an ash pan, which shall prevent ashes from dropping onto the bituminous concrete or seal coat.

Testing Surface. Before placing the seal coat, the surface of the bituminous concrete shall be tested wtih a four (4) foot straight edge laid longitudinally upon any portion of the surface, and any depression or other irregularity exceeding three-eighths (3/8) inch shall be satisfactorily eliminated.

Seal Coat. As soon as possible after the compaction of the bituminous concrete, when the surface is clean and dry, a seal coat of the hot asphalt cement shall be evenly distributed over the bituminous concrete and uniformly spread by means of squeegees. The asphalt cement shall be applied at a temperature not less than 135° C. (275°F.), nor more than 177° C. (350° F.), at a rate of one-half (1/2) to one (1) gallon per square yard, as directed. A thin, uniform layer of dry, clean broken stone chips shall be immediately uniformly spread in two applications over the asphalt cement by machines or skilled workmen. Each application of broken stone chips shall be rolled twice by a self-propelled, tandem roller. The spreading of the broken stone chips shall not lag more than twenty (20) feet behind the placing of the asphalt cement coating. Broken stone chips shall not be placed on the wearing course before the asphalt cement of the seal coat is applied. The surface of the bituminous concrete shall be kept scrupulously clean until the seal coat is applied, and the contractor shall not permit any hauling over the wearing course before the completion of the seal coat.

Seasonal and Weather Limitations. No bituminous concrete shall be mixed or placed when the air temperature in the shade is below 10° C. (50° F.).

Payment.

Measurement and Payment. The quantity of bituminous concrete wearing course to be paid for under this item shall be the number of square yards, measured horizontally, satisfactorily completed in accordance with the specifications. The price stipulated in this item shall include the furnishing, crushing and screening of the broken stone, including the broken stone chips for the seal coat, and

heating, mixing, placing and rolling of the broken stone and the asphalt cement or refined tar, and all work and expenses incidental to the completion of the bituminous concrete and the seal coat, except the furnishing of the bituminous cement, which will be included for payment under the item "Asphalt Cements and Refined Tars for Wearing Course of Bituminous Concrete Pavement" or the items "Asphalt Cements and Refined Tars for Wearing Course of Bituminous Concrete Pavement" and "Asphalt Cements for Seal Coat for Bituminous Concrete Pavement." Measurement under this item shall not include any pavement repaired or relaid, except as provided for in the following paragraph.

Removing and Replacing Wearing Course. If the contractor removes, as directed, portions of the wearing course, and the work thus exposed for examination is found satisfactory, or if for any reason he shall be ordered to remove wearing course built in full accordance with his contract, he shall be paid for such excavation one-fourth the price per square yard stipulated in this item. If the wearing course after examination is found to be of acceptable quality, the original wearing course will be paid for as well as that used to refill the excavation. In connection with the removing and replacing of the wearing course in accordance with this paragraph, no quantity shall be measured as less than one square yard.

Specifications for Asphalt Cements and Refined Tars for Wearing Course of Bituminous Concrete Pavement and for Asphalt Cements for the Seal Coat if an Asphalt Cement is Used in the Bituminous Wearing Course.

Asphalt Cement "A" Optional With Asphalt Cements "B," "C," "D," "E" and Refined Tars "F" and "G."

(1) The asphalt cement shall be homogeneous, free from water and shall not foam when heated to 177° C. (350° F.).

(2) It shall show a flash point of not less than 205° C. (400° F.).

(3) Its specific gravity at a temperature of 25° C. (77° F.) shall be not less than 0.970 nor more than 1.000.

(4) When tested with a standard No. 2 needle by means of a Dow penetrometer (or other penetrometer giving the same results as the Dow machine), it shall show penetrations within the following limits for the conditions stated, the penetrations being expressed in hundredths of a centimeter: 100 gram load, 5 seconds, at 25° C. (77° F.), from 75 to 90; 200 gram load, 1 minute, at 4° C. (39° F.), not less than 35; 50 gram load, 5 seconds, at 46° C. (115° F.), not more than 250.

(5) Its melting point as determined by the cube method shall be not less than 55° C. (131° F.).

(6) When 50 grams of the material is maintained at a uniform temperature of 163° C. (325° F.) for 5 hours in an open cylindrical tin dish, 5½ centimeters (about 2¼ inches) in diameter, with vertical sides measuring approximately 3½ centimeters (about 1½ inches) in depth, the loss in weight shall not exceed 1.0 per cent of the original weight of the sample.

The penetration of the residue, when tested as described in clause (4) with a standard No. 2 needle under a load of 100 grams, for 5 seconds at 25° C. (77° F.) shall be not less than one-half the penetration of the original material tested under the same conditions.

(7) Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall not be less than 99.5 per cent.

(8) It shall be soluble in chemically pure carbon tetrachloride at room temperature to the extent of not less than 99.5 per cent of its bitumen as determined by clause (7).

(9) It shall be soluble in 86° to 88° Baume paraffin naphtha, at least 85 per cent distilling between 40° and 55° C. (104° and 131° F.) to the extent of not less than 70.0 per cent nor more than 80.0 per cent of its bitumen as determined by clause (7).

(10) It shall yield not less than 8.0 per cent nor more than 12.0 per cent of fixed carbon.

Asphalt Cement "B" Optional with Asphalt Cements "A," "C," "D," "E" and Refined Tars "F" and "G."

(1) The asphalt cement shall be homogeneous, free from water and shall not foam when heated to 177° C. (350° F.).

(2) It shall show a flash point of not less than 205° C. (400° F.).

(3) Its specific gravity at a temperature of 25° C. (77° F.) shall be not less than 1.000 nor more than 1.030.

(4) When tested with a standard No. 2 needle by means of a Dow penetrometer (or other penetrometer giving the same results as the Dow machine), it shall show penetrations within the following limits for the conditions stated, the penetrations being expressed in hundredths of a centimeter: 100 gram load, 5 seconds, at 25° C. (77° F.), from 90 to 100; 200 gram load, 1 minute at 4° C. (39° F.), not less than 30.

(5) Its melting point as determined by the cube method shall be not less than 50° C. (122° F.).

(6) When 50 grams of the material is maintained at a uniform temperature of 163° C. (325° F.) for 5 hours in an open cylindrical tin dish, 5½ centimeters (about 2¼ inches) in diameter, with vertical sides measuring approximately 3½ centimeters (about 1½ inches) in depth, the loss in weight shall not exceed 1.0 per cent of the original weight of the sample.

The penetration of the residue, when tested as described in clause (4) with a standard No. 2 needle under a load of 100 grams, for 5 seconds at 25° C. (77° F.) shall be not less than one-half the penetration of the original material tested under the same conditions.

(7) Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall not be less than 99.5 per cent.

(8) It shall be soluble in chemically pure carbon tetrachloride at room temperature to the extent of not less than 99.5 per cent of its bitumen as determined by clause (7).

(9) It shall be soluble in 86° to 88° Baume paraffin naphtha, at least 85 per cent distilling between 40° and 55° C. (104° and 131° F.) to the extent of not less than 72.0 per cent nor more than 78.0 per cent of its bitumen as determined by clause (7).

(10) It shall yield not less than 11.0 per cent nor more than 15.0 per cent of fixed carbon.

Asphalt Cement "C" Optional With Asphalt Cements "A," "B," "D," "E" and Refined Tars "F" and "G."

(1) The asphalt cement shall be homogeneous, free from water and shall not foam when heated to 177° C. (350° F.).

(2) It shall show a flash point of not less than 205° C. (400° F.).

(3) Its specific gravity at a temperature of 25° C. (77° F.) shall be not less than 1.030 nor more than 1.040.

(4) When tested with a standard No. 2 needle by means of a Dow penetrometer (or other penetrometer giving the same results as the Dow machine), it shall show penetrations within the following limits for the conditions stated, the penetrations being expressed in hundredths of a centimeter; 100 gram load, 5 seconds, at 25° C. (77° F.), from 70 to 90; 200 gram load, 1 minute, at 4° C. (39° F.), not less than 10.

(5) Its melting point as determined by the cube method shall be not less than 45° C. (113° F.).

(6) When 50 grams of the material is maintained at a uniform temperature of 163° C. (325° F.) for 5 hours in an open cylindrical tin dish, 5½ centimeters (about 2¼ inches) in diameter, with vertical sides measuring approximately 3½ centimeters (about 1½ inches) in depth, the loss in weight shall not exceed 2.0 per cent of the original weight of the sample.

The penetration of the residue, when tested as described in clause (4) with a standard No. 2 needle under a load of 100 grams, for 5 seconds at 25° C. (77° F.) shall be not less than one-half the penetration of the original material tested under the same conditions.

(7) Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall not be less than 99.5 per cent.

(8) It shall be soluble in chemically pure carbon tetrachloride at room temperature to the extent of not less than 99.5 per cent of its bitumen as determined by clause (7).

(9) It shall be soluble in 86° to 88° Baume paraffin naphtha, at least 85 per cent distilling between 40° and 55° C. (104° and 131° F.) to the extent of not less than 80.0 per cent nor more than 88.0 per cent of its bitumen as determined by clause (7).

(7) Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall be not less than 93.0 per cent nor more than 98.0 per cent.

(8) It shall be soluble in chemically pure carbon tetrachloride at room temperature to the extent of not less than 98.5 per cent of its bitumen as determined by clause (7).

(9) It shall be soluble in 86° to 88° Baume paraffin naphtha, at least 85 per cent distilling between 40° and 55° C. (104° and 131° F.) to the extent of not less than 75.0 per cent nor more than 85.0 per cent of its bitumen as determined by clause (7).

(10) It shall yield not less than 11.0 per cent nor more than 15.0 per cent of fixed carbon.

(11) Upon ignition it shall yield not less than 1.0 per cent nor more than 3.0 per cent of ash.

Refined Tar "F" Optional With Asphalt Cements "A," "B," "C," "D," "E" and Refined Tar "G."

(1) The refined tar shall be homogeneous, free from water and shall not foam when heated to 150° C. (302° F.).

(2) Its specific gravity at a temperature of 25° C. (77° F.) shall be not less than 1.160 nor more than 1.200.

(3) When tested by means of the New York Testing Laboratory Float Apparatus, the float shall not sink in water maintained at 50° C. (122° F.) in less than 140 seconds nor more than 170 seconds.

(4) Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall be not less than 95.0 per cent and it shall show not more than 0.2 per cent ash upon ignition of the material insoluble in carbon disulphide.

(5) When distilled according to the tentative method recommended by Committee D-4 of the American Society for Testing Materials in 1911, it shall yield no distillate at a temperature lower than 170° C. (338° F.); not more than 7.0 per cent by weight shall distill below 270° C. (518° F.), and not more than 20.0 per cent by weight shall distill below 300° C. (572° F.).

(6) The total distillate from the test made in accordance with clause (5) shall have a specific gravity at a temperature of 25° C. (77° F.) of not less than 1.000 nor more than 1.020.

(7) The melting point, as determined in water by the cube method, of the pitch residue remaining after distillation to 300° C. (572° F.), in accordance with the test described in clause (5), shall be not more than 75° C. (167° F.).

Refined Tar "G" Optional With Asphalt Cements "A," "B," "C," "D," "E" and Refined Tar "F."

(1) The refined tar shall be homogeneous, free from water and shall not foam when heated to 150° C. (302° F.).

(2) Its specific gravity at a temperature of 25° C. (77° F.) shall be not less than 1.200 nor more than 1.300.

(3) When tested by means of the New York Testing Laboratory Float Apparatus, the float shall not sink in water maintained at 50° C. (122° F.) in less than 140 seconds nor more than 170 seconds.

(4) Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall be not less than 75.0 per cent nor more than 90.0 per cent, and it shall not show more than 0.2 per cent ash upon ignition of the material soluble in carbon disulphide.

(5) When distilled according to the tentative method recommended by Committee D-4 of the American Society for Testing Materials in 1911, it shall yield no distillate at a temperature lower than 170° C. (338° F.); not more than 10.0 per cent by weight shall distill below 270° C. (518° F.), and not more than 20.0 per cent by weight shall distill below 300° C. (572° F.).

(6) The total distillate from the test made in accordance with clause (5) shall have a specific gravity at a temperature of 25° C. (77° F.) of not less than 1.030.

(7) The melting point, as determined in water by the cube method, of the pitch residue remaining after distillation to 300° C. (572° F.), in accordance with the test described in clause (5), shall be not more than 75° C. (167° F.).

SPECIFICATIONS FOR ASPHALT CEMENTS FOR SEAL COAT FOR BITUMINOUS CONCRETE PAVEMENT WHEN REFINED TAR IS USED IN THE BITUMINOUS CONCRETE WEARING COURSE.

Asphalt Cement "H" Optional With Asphalt Cements "K" and "L."

(1) The asphalt cement shall be homogeneous, free from water and shall not foam when heated to 177° C. (350° F.).

(2) It shall show a flash point of not less than 205° C. (400° F.).

(3) Its specific gravity at a temperature of 25° C. (77° F.) shall be not less than 0.970 nor more than 1.000.

(4) When tested with a standard No. 2 needle by means of a Dow penetrometer (or other penetrometer giving the same results as the Dow machine), it shall show penetrations within the following limits for the conditions stated, the penetrations being expressed in hundredths of a centimeter: 100 gram load, 5 seconds, at 25° C. (77° F.), from 60 to 75; 200 gram load, 1 minute, at 4° C. (39° F.), not less than 50; 50 gram load, 5 seconds, at 46° C. (115° F.), not more than 150.

(5) Its melting point as determined by the cube method shall be not less than 80° C. (176° F.).

(6) When 50 grams of the material is maintained at a uniform temperature of 163° C. (325° F.) for 5 hours in an open cylindrical tin dish, 5½ centimeters (about 2¼ inches) in diameter, with vertical sides measuring approximately 3½ centimeters (about 1½ inches) in depth, the loss in weight shall not exceed 1.0 per cent of the original weight of the sample.

The penetration of the residue, when tested as described in clause (4) with a standard No. 2 needle under a load of 100 grams, for 5 seconds at 25° C. (77° F.) shall be not less than one-half the penetration of the original material tested under the same conditions.

(7) Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall not be less than 99.5 per cent.

(8) It shall be soluble in chemically pure carbon tetrachloride at room temperature to the extent of not less than 99.5 per cent of its bitumen as determined by clause (7).

(9) It shall be soluble in 86° to 88° Baume paraffin naphtha, at least 85 per cent distilling between 40° and 55° C. (104° and 131° F.) to the extent of not less than 70.0 per cent nor more than 80.0 per cent of its bitumen as determined by clause (7).

(10) It shall yield not less than 8.0 per cent nor more than 12.0 per cent of fixed carbon.

Asphalt Cement "K" Optional With Asphalt Cements "H" and "L."

(1) The asphalt cement shall be homogeneous, free from water and shall not foam when heated to 177° C. (350° F.).

(2) It shall show a flash point of not less than 205° C. (400° F.).

(3) Its specific gravity at a temperature of 25° C. (77° F.) shall be not less than 1.030 nor more than 1.045.

(4) When tested with a standard No. 2 needle by means of a Dow penetrometer (or other penetrometer giving the same results as the Dow machine), it shall show penetrations within the following limits for the conditions stated, the penetrations being expressed in hundredths of a centimeter: 100 gram load, 5 seconds, at 25° C. (77° F.), from 60 to 70; 200 gram load, 1 minute, at 4° C. (39° F.), not less than 18; 50 gram load, 5 seconds, at 46° C. (115° F.), not more than 270.

(5) Its melting point as determined by the cube method shall be not less than 60° C. (140° F.).

(6) When 50 grams of the material is maintained at a uniform temperature of 163° C. (325° F.) for 5 hours in an open cylindrical tin dish, 5½ centimeters (about 2¼ inches) in diameter, with vertical sides measuring approximately 3½ centimeters (about 1½ inches) in depth, the loss in weight shall not exceed 1.0 per cent of the original weight of the sample.

The penetration of the residue, when tested as described in clause (4) with a standard No. 2 needle under a load of 100 grams, for 5 seconds at 25° C. (77° F.) shall be not less than one-half the penetration of the original material tested under the same conditions.

(7) Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall not be less than 99.5 per cent.

(8) It shall be soluble in chemically pure carbon tetrachloride at room temperature to the extent of not less than 99.5 per cent of its bitumen as determined by clause (7).

(9) It shall be soluble in 86° to 88° Baume paraffin naphtha, at least 85 per cent distilling between 40° and 55° C. (104° and 131° F.) to the extent of not less than 70.0 per cent nor more than 80.0 per cent of the bitumen as determined by clause (7).

(10) It shall yield not less than 12.0 per cent nor more than 16.0 per cent of fixed carbon.

Asphalt Cement "L" Optional with Asphalt Cements "H" and "K."

(1) The asphalt cement shall be homogeneous, free from water and shall not foam when heated to 177° C. (350° F.).

(2) It shall show a flash point of not less than 205° C. (400° F.).

(3) Its specific gravity at a temperature of 25° C. (77° F.) shall be not less than 1.025 nor more than 1.055.

(4) When tested with a standard No. 2 needle by means of a Dow penetrometer (or other penetrometer giving the same results as the Dow machine), it shall show penetrations within the following limits for the conditions stated, the penetrations being expressed in hundredths of a centimeter: 100 gram load, 5 seconds, at 25° C. (77° F.), from 60 to 70; 200 gram load, 1 minute, at 4° C. (39° F.), not less than 16.

(5) Its melting point as determined by the cube method shall be not less than 55° C. (131° F.).

(6) When 50 grams of the material is maintained at a uniform temperature of 163° C. (325° F.) for 5 hours in an open cylindrical tin dish, 5½ centimeters (about 2¼ inches) in diameter, with vertical sides measuring approximately 3½ centimeters (about 1½ inches) in depth, the loss in weight shall not exceed 1.0 per cent of the original weight of the sample.

The penetration of the residue, when tested as described in clause (4) with a standard No. 2 needle under a load of 100 grams, for 5 seconds at 25° C. (77° F.) shall be not less than one-half the penetration of the original material tested under the same conditions.

(7) Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall not be less than 99.5 per cent.

(8) It shall be soluble in chemically pure carbon tetrachloride at room temperature to the extent of not less than 99.5 per cent of its bitumen as determined by clause (7).

(9) It shall be soluble in 86° to 88° Baume paraffin naphtha, at least 85 per cent distilling between 40° and 55° C. (104° and 131° F.), to the extent of not less than 67.0 per cent nor more than 77.0 per cent of its bitumen as determined by clause (7).

(10) It shall yield not less than 13.0 per cent nor more than 18.0 per cent of fixed carbon.

Delivery. The asphalt cement or refined tar shall be delivered in suitable containers, far enough in advance of its use in the work to permit the necessary tests to be made. Each container shall be plainly labeled with the trade name of the asphalt cement or refined tar, name of manufacturer, gross weight and net weight. Each shipment and each carload shall be kept separate.

Bills of Lading. The contractor shall furnish the engineer on or before the arrival of each shipment at or near the site of the work, bills of lading, or correct copies thereof, which shall state the trade name of the asphalt cement or refined tar, and the name and address of the company manufacturing and supplying it.

Samples. Samples will be taken by the engineer from each carload of asphalt cement or refined tar when delivered at the work, unless satisfactory arrangements can be made for sampling before shipment. Such samples shall be analyzed by the engineer to assure the delivery of an asphalt cement or refined tar of the specified quality and to determine, for purpose of payment, the quantity of bitumen.

Work Included. Under this item the contractor shall furnish and deliver on the work at such points as directed an asphalt cement or an asphalt cement and a refined tar, which conform with the

specifications heretofore mentioned. All asphalt cement or refined tar for any pavement of a given contract shall be furnished by one manufacturer and no change in type or grade of bituminous cement used in the bituminous concrete or the seal coat shall be allowed in any pavement of a given contract without written permission from the engineer.

Measurement and Payment. The quantity of bitumen in the asphalt cement or refined tar, to be paid for under this item, shall be the number of tons, determined in accordance with the paragraph headed "Samples," contained in the asphalt cement or refined tar placed in the pavement in accordance with the specifications and requirements, or used as directed for other purposes. The percentage of bitumen determined by an average of the analyses of the acceptable samples taken by the engineer during a given month, shall be used as the basis for payment for the asphalt cement or refined tar used during that month. Asphalt cement or refined tar that is wasted shall not be included in the measurement under this item. The price stipulated in this item shall include the cost of furnishing, hauling and delivering the asphalt cement or refined tar at points on the work where it is to be used, and all expenses incidental thereto.

DISCUSSION.

MR. KINGSLEY: While we appreciate the work Mr. Blanchard's committee has done, it strikes us that the Bituminous Paving Committee has gone very thoroly over a good portion of the ground, and consequently we are approaching the subject with two committee reports on very nearly the same thing. I think that matter ought to be thought of before this is adopted.

PROF. BLANCHARD: A word of explanation is necessary. This is an independent specification drawn to cover a bituminous concrete pavement, the mineral aggregate of which is composed of one product of a stone crushing plant. At the 1914 convention of this Society, at the request of Mr. Linn White, the chairman of the Committee on Bituminous Paving, the Committee on Standard Specifications instructed the committee of which I am chairman to bring before this convention this specific specification. I, therefore, do not see why it is necessary to delay consideration or adoption of this specification until after other specifications are considered.

MR. WHITE: I would like to state that my recollection agrees with that of Prof. Blanchard as to the request that his committee handle this particular pavement, which I understand is briefly described as a broken stone mixture, without any of the finer ingredients. I think the question that Mr. Kingsley had in mind is whether it is properly termed bituminous concrete. Now, that has been informally spoken of between myself and Prof. Blanchard, without attempting to arrive at any definite conclusion, feeling that the matter should go up to the convention in the form he has prepared it. At the Grand Rapids meeting there was a definition adopted by this Society of bituminous concrete. I am not sure that this specification for a broken stone mixture would come strictly within the limits of that definition. This specification undoubtedly describes a character of pavement that has been laid with success in some sections of the country, but whether it is a bituminous concrete within the meaning of the definition formerly adopted, I think the Society should determine.

PROF. BLANCHARD: Mr. President, I regret very much that this subject is up for discussion. At the Grand Rapids Convention a report was presented by Mr. Linn White, the chairman of the Committee on Nomenclature of Bituminous Pavements. The other members of that committee consisted of Major W. W. Crosby and myself. We never saw that report and we never accepted it. The report was printed, and unfortunately our names were attached to it. Almost at the same time a Committee of the American Society of Civil Engineers adopted this definition: "Bituminous concrete pavement, one composed of stone, gravel, sand, shale or slag, or combinations thereof, and bituminous materials incorporated together by mixing methods." In connection with a consideration of that definition, it is of interest to note that two esteemed past presidents of this Society are members of that Committee, and have subscribed to that definition. Possibly at the time that Mr. White presented his report there was a general unanimity of opinion in the Middle West pertaining to the constituents of bituminous concrete. In many localities, however, there has been a general line of demarcation between bituminous macadam and bituminous concrete on the basis of the bituminous macadam pavement being constructed by penetration methods and the bituminous concrete pavement being constructed by mixing methods. The committee of the American Society of Civil Engineers felt that this basis was the most logical in order to simplify the nomenclature

of bituminous pavements. Mr. President, there is no chance for misunderstanding in regard to this specification, as it definitely states it is a bituminous concrete pavement having a mineral aggregate consisting of one product of a stone crushing plant. There are, in addition to this type of bituminous concrete pavement, many types. It is impossible to accurately describe a bituminous concrete pavement to any engineer by simply saying it is a bituminous concrete pavement. The several types depend upon the character of the mineral aggregate.

MR. SMITH: For my information, may I ask Prof. Blanchard what size of stone composes the mineral aggregate of the pavement?

PROF. BLANCHARD: The clause covering the broken stone for mineral aggregate in bituminous concrete specifications may be framed up in various ways. Keeping in mind the very definite instructions which were given to the sub-committee on Broken Stone and Gravel Roads at the Wilmington convention, the sub-committee has endeavored to transmit its thought thru the medium of this paragraph to the engineers composing the Society. It might be stated that the broken stone shall pass over a one-quarter, three-eighths, one-half, five-eighths inch screen, and thru an inch and a quarter. Those who have had experience with various types of crushing plants, know that many variations in the product may be expected. It is, therefore, the desire of the committee to show exactly what they considered this product, within reasonable limitations, should consist of, rather than depend upon the very variable factors of size of openings in various rotary screens, and go into all the details of manipulation of the stone crushing and screening plants, which is necessary in order to get a desired product. This paragraph reads as follows: "Broken stone for the mineral aggregate of the wearing course shall consist of one product of the stone crushing and screening plant. It shall conform to the following mechanical analysis, using laboratory screens having circular openings. All of the broken stone shall pass a one and one-quarter inch screen. Not more than ten per cent nor less than one per cent shall be retained upon a one inch screen; not more than ten per cent nor less than three per cent shall pass a one-quarter inch screen." The limits in this specification cover the typical mineral aggregate used in the State of Rhode Island since 1906, the aggregate of the experimental pavement constructed on Hillside Avenue in the

Boro of Queens, which carries a traffic of from two thousand to five thousand vehicles a day, and the mineral aggregate of the thirty-five miles of bituminous concrete pavement constructed, during the past three years, around the Ashokan Reservoir by the Board of Water Supply of the City of New York.

MR. SHERRERD: Mr. President, the general committee were a little puzzled about the question of names, but it seems to me that if this describes a satisfactory pavement which has been laid, as we understand, successfully, the question of name is really immaterial. It will be necessary from time to time, as the state of the art progresses, to find revise the nomenclature of the different classifications of pavements, and I would therefore support Prof. Blanchard's recommendation that this specification be adopted.

REPORT OF SUB-COMMITTEE ON SPECIFICATIONS FOR STONE BLOCK PAVING.

The sub-committee on Stone Block Paving herewith submits to you with a recommendation that they be adopted by the society, a revised stone block specification. The changes are as follows:

1. The crushing strength test for granite has been omitted as it has been proven by many tests and by service that the crushing strength of a granite has very little bearing on its value as a pavement.

2. The test for "French Co-efficient of Wear" has been added as the committee believes it to be the best available test for wearing quality.

3. Two tests for Toughness and French Co-efficient of Wear are given. While the committee believes the higher tests will produce the better pavement; still it was obliged to recognize the fact that many granites are available for paving in certain localities, where they have given satisfaction, which would be excluded by the higher tests.

4. The gravel has been omitted from the cement grout filler specification, as it has been demonstrated that the use of gravel in the joints of a cement grouted granite pavement has caused trouble by preventing the grout from flowing to the bottom of the joint.

5. The second coating of grout has been changed from a mixture of two parts of cement and one part of sand to one part of cement and one part of sand, as there is no good reason for the excess of cement in the second coating.

6. Many minor changes have been made to eliminate repetition and other unnecessary matter and the wording has also been somewhat changed in order to more clearly express the intent.

The committee considered the advisability of changing the dimensions of the blocks to a block four inches in depth. It believes such blocks can be used to good advantage, but blocks of that depth are not now in general use, nor is the amount of data available sufficient to warrant the change at this time.

The committee also considered the advisability of specifying a joint filler made by mixing equal parts of sand and coal-tar, pitch or asphalt. While the committee strongly recommends the trial of such a filler, it was not thought advisable at this time to classify this filler as a standard filler, as very little is known regarding its general adaptability nor its durability under widely varying conditions.

The committee would also call attention to the importance of obtaining more traffic statistics and to the necessity for the adoption by the society of a traffic unit in order that specifications may be written in terms of the traffic for which the pavement is designed.

Herman H. Schmidt, Chairman.
Jno. E. Ramsay,
Geo. A. Carpenter,
N. S. Sprague,
M. R. Sherrerd,
John B. Hittell.

TESTS.

(To be substituted for second paragraph, Page 3, of 1914 Edition of specifications.)

For heavy traffic the granite shall have a toughness of not less than nine (9) and a "French Co-efficient of Wear" of not less than eleven (11). For medium traffic the granite may have a toughness of not less than seven (7) and a "French Co-efficient of Wear" of not less than eight (8), if a cement grout filler is used.

The above tests shall be made by the methods described in Bulletin Number 44, U. S. Department of Agriculture, Office of Public Roads.

The average of three (3) tests shall be used for determining toughness, and the average of six (6) tests for determining the "French Co-efficient of Wear."

(To be substituted for last one-half of paragraph 2, Certificates and Samples, Page 3.)

On or before the date of the letting, six (6) specification blocks made from the granite it is proposed to use, shall be filed with the engineer.

(Top of Page 9 to be inserted as a paragraph after 9th line, Page 7.)

It shall be delivered where directed by the engineer, at least one week before being used, to allow for examination and analysis.

If shrinkage of the filler in the joints occurs, the pouring shall be continued until all joints remain permanently filled, but no flushing of the pavement will be permitted.

(This paragraph is also to remain at top of Page 9.)

(Note regarding 4-inch block to be inserted at the end of the specifications.)

Note: When in the judgment of the engineer, a shallower block than that before specified is deemed desirable, a block 3¾ to 4¼ inches wide, 3¾ to 4¼ inches deep and 7 to 11 inches long, may be used; provided, the granite has a sufficiently high factor of toughness and "French Co-efficient of Wear."

SPECIFICATIONS FOR STONE BLOCK PAVING.

Adopted October 14, 1915.

These specifications will be modified from time to time to keep them fully up to date. Suggestions as to modifications or additions are solicited and should be sent to the Secretary, or to H. H. Schmidt, Chief Engineer Bureau of Highway, Brooklyn, N. Y., Chairman of the Sub-Committee on Specifications for Stone Block Paving, and George W. Tillson, Boro Hall, Brooklyn, New York, Chairman of General Committee on Standard Specifications.

New Granite Paving Blocks.

1. The paving blocks shall be of medium grained granite, showing an even distribution of constituent minerals, of uniform quality structure and texture, without seams, scales or disintegration, free from an excess of mica or feldspar, and equal in every respect to the sample in the office of the engineer.

Tests.

For heavy traffic the granite shall have a toughness of not less than nine (9) and a "French Co-efficient of Wear" of not less than eleven (11). For medium traffic, the granite may have a toughness

of not less than seven (7) and a "French Co-efficient of Wear" of not less than eight (8) if a cement grout filler is used.

The above tests shall be made by the methods described in Bulletin No. 44, U. S. Department of Agriculture, Office of Public Roads.

The average of three (3) tests shall be used for determining toughness and the average of six (6) tests for determining the "French Co-efficient of Wear."

CERTIFICATES AND SAMPLES.

2. Contractors shall file with the engineer at or before the time of bidding, a certificate showing the name and location of the quarry from which it is proposed to obtain the blocks, also a certified copy of a report from the United States Department of Agriculture, showing the toughness and "French Co-efficient of Wear" of the granite which it is proposed to use.

On or before the date of the letting, six (6) specification blocks, made from the granite it is proposed to use, shall be filed with the engineer.

3. The blocks shall be of the following dimensions: Not less than eight (8) nor more than twelve (12) inches long on top; not less than three and one-half (3½) nor more than four and one-half (4½) inches wide on top; not less than four and three-quarters (4¾) nor more than five and one-quarter (5¼) inches deep.

The blocks shall be so dressed that the faces will be approximately rectangular in shape, and the ends and sides sufficiently smooth to permit the blocks to be laid with joints not exceeding one-half (½) inch in width at the top, and for one (1) inch downward therefrom, and not exceeding one (1) inch in width at any other part of the joint. The top surface of the block shall be so cut that there will be no depressions measuring more than three-eighths (⅜) of an inch from a straight edge laid in any direction on the top and parallel to the general surface thereof.

Care shall be exercised in handling the blocks, so that the edges and corners shall not be chipped or broken, as blocks otherwise acceptable may be rejected on account of spawling.

4. The blocks shall be sorted and laid in courses of uniform width, except in special cases, as may be ordered.

New Sandstone Paving Blocks.

5. The paving blocks shall be of sound, hard sandstone, free from clay, seams, or defects which would injure them for paving purposes, of uniform quality and texture, and equal in every respect to the sample in the office of the engineer.

The blocks shall be of the following dimensions: Not less than eight (8) nor more than ten (10) inches long on top; not less than three and one-half (3½) nor more than six (6) inches wide on top; not less than four and three-quarters (4¾) nor more than five and one-quarter (5¼) inches deep.

Recut or Redressed Paving Blocks.

6. When the use of blocks recut from old paving blocks is permitted, such blocks must comply with the specifications for quality of stone, as required for new blocks. The dimensions may be varied, depending upon the size of the old blocks which are to be redressed, and the character of the pavement which it is sought to obtain.

Sub-Foundation.

7. Any soft or spongy material below the sub-grade, shall be replaced with sand, gravel, or other material, as directed by the engineer, and thoroly rammed or rolled. When such extra fill exceeds five (5) cubic yards, payment will be made for the excess.

Care shall be taken in excavating not to disturb the sub-foundation, except where necessary to remove the soft or spongy material.

The entire sub-foundation shall be compact and hard, and the contractor shall be required to ram or roll it thoroly with a roller satisfactory to the engineer.

Concrete Base.

8. After the sub-foundation has been prepared to the satisfaction of the engineer, a concrete foundation six (6) inches thick shall be laid thereon. The concrete shall conform to the A. S. M. I. specifications for concrete for pavement foundations.

The grading and sub-foundation shall be completed at least fifty (50) feet in advance of the laying of concrete.

CUSHION COURSE.

9. On the concrete base shall be spread a layer, averaging one (1) inch in depth, of clean, coarse, dry sand, free from all gravel exceeding one-quarter (1/4) inch in size. Upon this sand bed the blocks shall be laid in courses at right angles to the line of the street, and in a straight line from curb to curb, except in special cases, when they shall be laid at such an angle as may be directed by the engineer. The blocks shall be laid as closely as possible, each block touching the adjoining one on sides and ends, and in courses of uniform width. All joints shall be broken with a lap of at least three (3) inches. The blocks shall not be laid more than twenty-five (25) feet in advance of the ramming.

FILLING JOINTS.

10. The following specifications A, B, or C, shall govern the use of —Gas-Tar Pitch (A)—Asphalt (B)—or Cement Grout (C), depending upon the kind of filler to be used in the joints:

A.—GAS-TAR PITCH FILLER.

11. Immediately after the blocks are laid, coarse, hot gravel shall be spread over the surface, and shall be swept into the joints so as to fill the space between the blocks to a depth not exceeding two (2) inches from the bottom.

The blocks shall then be rammed, to settle and compact thoroly the gravel in the joints, and so as to leave no blocks above or below the general surface of the finished pavement.

The joints shall then be poured one-half full with the gas-tar pitch filler, hereinafter described, and shall be filled immediately to within one-half (1/2) inch of the surface with hot gravel and again poured with the filler. This last pouring shall fill the joints flush with the surface of the blocks and shall be followed immediately with a sufficient amount of hot gravel applied at the joints to cover the filler.

The gravel shall be clean, washed gravel, between one-quarter (1/4) and one-half (1/2) inch in its largest dimension.

The gas-tar pitch shall comply with the following requirements:

(a) It shall have a specific gravity between 1.23 and 1.33 at 60 degrees Fahr.

(b) It shall have a melting point between 110 and 125 degrees Fahr., determined by the cube method in water.

(c) It shall contain not less than twenty (20) per cent, nor more than thirty-five (35) per cent of free carbon insoluble in hot benzol or chloroform.

(d) It shall contain not more than one-half (½) per cent. of inorganic matter.

(e) It shall be free from water.

(f) It shall have a ductility of not less than sixty (60) centimeters at 77 degrees Fahr.

The gas-tar pitch filler shall be used on the work at a temperature of not less than two hundred and fifty (250) degrees Fahr. and shall at no time be heated above three hundred and twenty-five (325) degrees Fahr.

It shall be delivered where directed by the engineer at least one week before being used, to allow for examination and analysis. If shrinkage of the filler in the joints occurs, the pouring shall be continued until all joints remain permanently filled, but no flushing of the pavement will be permitted.

In applying the gravel and filler, care shall be taken that the pavers are closely followed by the filler gang, and in no case shall the paving be left over night, or when work is stopped, without the filling of the joints being completed. In case rain stops the filler gang before its work is finished, the joints shall be protected by the use of tarpaulins, or other means to keep out water. Under no circumstances shall the filler be poured into wet joints.

B—Asphalt Filler.

12. Immediately after the blocks are laid, coarse hot gravel shall be spread over the surface and shall be swept into the joints so as to fill the space between the blocks to a depth not exceeding two (2) inches from the bottom.

The blocks shall then be rammed to settle and compact thoroly the gravel in the joints, and so as to leave no blocks above or below the general surface of the finished pavement.

The joints shall then be poured one-half full with the asphalt filler as hereinafter described, and shall be filled immediately to within one-half (½) inch of the surface with hot gravel and again poured with the filler. This last pouring shall fill the joints flush with the surface of the blocks and shall be followed immediately with a sufficient amount of hot gravel applied at the joints to cover the filler.

The gravel shall be clean, washed gravel between one-quarter (¼) and one-half (½) inch in its largest dimension.

13. The filler shall be an asphaltic cement, entirely free from coal tar or any product of coal tar distillation.

It shall be waterproof, free from water or decomposition products, shall adhere firmly to the paving stones, and shall remain ductile and pliable at all climatic temperatures to which it may be subjected in actual use. It shall not run in the joints in the hottest temperature of summer, nor become hard or brittle through the action of frost.

The asphalt filler shall comply with the following requirements:

(a) It shall contain not less than 99 per cent of pure bitumen soluble in carbon bisulphide.

(b) Of the total bitumen soluble in carbon bisulphide, not less than 98½ per cent shall be soluble in carbon tetrachloride.

(c) It shall have a penetration of not less than 13 at 32 degrees Fahr., when tested with a No. 2 needle under a load of 200 grams for 1 minute.

(d) It shall have a penetration of not more than 250 at 115 degrees Fahr., when tested with a No. 2 needle under a load of 50 grams for 5 seconds.

(e) It shall have a penetration of not less than 40 nor more than 60 at 77 degrees Fahr., when tested with a No. 2 needle under a weight of 100 grams for 5 seconds.

(f) It shall have a ductility of not less than 7 centimeters at 77 degrees Fahr., the rate of elongation being 5 centimeters per minute.

It shall be heated on the work to a temperature of not less than three hundred and seventy-five (375) degrees Fahr., nor more than four hundred and twenty-five (425) degrees Fahr., and in such

quantities as will allow this temperature to be maintained in the kettle during progress of the pouring. No cement having a temperature less than three hundred and seventy-five (375) degrees Fahr., shall be used.

It shall be delivered, where directed by the engineer, at least one week before being used, to allow for examination and analysis. If shrinkage of the filler in the joints occurs, the pouring shall be continued until all joints remain permanently filled but no flushing of the pavement will be permitted.

In applying the gravel and filler, care shall be taken that the pavers are closely followed by the filler gang, and in no case shall the paving be left over night, or when work is stopped, without the filling of the joints being completed. In case rain stops the filler gang before its work is finished, the joints shall be protected by tarpaulins or other means, so as to keep out water. Under no circumstances shall the filler be poured into wet joints.

C—Cement Grout Filler.

14. Immediately after the blocks are laid, they shall be thoroly rammed and brought to an even and true surface.

15. After the pavement has been brought to a uniform surface, portland cement grout shall be poured into the joints until it appears on the surface. The grout shall be broomed into the joints, if necessary to fill the same, and the operation shall be continued as the grout settles, until the joints are thoroly filled flush with the surface of the blocks. Immediately after this, the entire pavement shall be broomed to a smooth surface. The blocks shall be wetted immediately before applying the grout.

The cement grout shall be composed of one (1) part of Portland cement and one (1) part of clean sharp sand. The cement and sand shall be thoroly mixed dry and sufficient clean, fresh water shall be added to give the grout proper consistency.

The grout shall be mixed for this purpose, either in a machine mixer, to be approved by the engineer, or in a box about 4 feet 8 inches long, 30 inches wide and 14 inches deep, resting on legs of different lengths, so that the mixture will readily flow to one corner of the box, the bottom of which shall be about 3 inches above the pavement. Particular attention is called to the importance of ascer-

taining the proportional amount of water to be used with the mixture of different kinds of cement and sand to give the best results. and when the most advantageous proportions have been ascertained, these shall be used. While being applied to the joints the mixture in the box shall be continuously stirred. One such box shall be provided for about each ten feet in width of the roadway.

The work of filling shall be carried forward until an advance area of fifteen or twenty yards has been grouted, when the same force and appliances shall be used to regrout the same space in a like manner

The work shall be kept lightly sprinkled with water ahead of the sweepers, to avoid a possibility of causing the grouting to become too thick at any point. To insure the penetration of the grout into the joints of the pavement a squeegee scraper fifteen to eighteen inches in length in addition to the brooms, shall be used upon the last application of the grout.

After the grout between the joints has fully subsided and the initial set is taking place, the whole surface shall be lightly sprinkled with water and the surplus grout left on the top shall be swept into the joints, bringing them up flush and full. After the grouting is completed and a sufficient time for hardening has elapsed, so that one-half (½) inch of sand shall be spread over the whole surface. a coating of sand will not absorb moisture from the cement mixture, In case the work is subjected to the direct rays of the sun, an occasional sprinkling shall be given for two or three days to dampen the sand.

After the grouting is completed, the street shall be kept closed and no carting or traffic allowed on any part of the grouted pavement until at least seven days have elapsed. The surface of the pavement shall be kept moist, as may be directed by the engineer.

Should the bond between the blocks become broken before the work is accepted, the joints shall be cleaned out, even if it is necessary to take up and relay the blocks. Such defective work shall be regrouted or relaid and again barricaded as previously described.

NOTE. When in the judgment of the engineer, a shallower block than that before specified is deemed desirable, a block 3¾ to 4¼ inches wide, 3¾ to 4¼ inches deep, and 7 to 11 inches long, may be used, provided, the granite has a sufficiently high factor of toughness and "French Co-efficient of wear."

REPORT OF SUB-COMMITTEE ON WOOD BLOCK PAVING SPECIFICATIONS.

The following specifications for wood block paving were presented by A. W. Dow, for the Sub-Committee on Wood Block Paving Specifications, to the Committee on Standard Specifications, and were presented as information, by the General Committee, to the Society on October 14, 1915. Mr. Dow's verbal report will be found on page 529 with discussion following.

Specifications For Creosoted Wood Block Paving.

Timber.

The wood to be treated shall be southern yellow pine, Norway pine, Douglas fire or tamarack. Only one kind of wood to be used in one contract. The blocks must be cut from a good grade of timber, and must be well manufactured, full size, square butted and square edged, free from the following defects: checks, unsound, loose or hollow knots, knotholes, worm holes, thru shakes and round shakes that show on the surface.

In yellow pine timber there shall be not less than four (4) annual rings in any one inch measured radially from the pitch center. Wherever in any one inch there are less than six (6) annual rings to the inch, the summer wood shall average not less than 25 per cent. All measurements are to be made on a section of wood cut out perpendicular to the grain. The blocks in each charge must average 80 per cent of heart wood, and no one block shall be accepted that contains less than 50 per cent heart wood.

Size of Blocks.

The blocks shall be from five to ten inches long, but shall average eight inches; they shall be *...... inches in depth. They shall be from three to four inches in width, but in any one city block all of them must be of uniform width. A variation of 1/16 inch shall be allowed in the depth and width of the blocks from that specified.

*Note.—The committee recommends blocks 4 inches in depth for heavy traffic streets; blocks 3½ inches in depth for medium to light traffic streets; for light traffic streets blocks 3 inches in depth may be used, but where 3-inch blocks are used no blocks shall be longer than 8 inches.

Preservative.

The preservative shall be wholly derived from coal gas tar or coke oven tar, and shall comply with the following requirements:

1st: The specific gravity shall be not less than 1.06 nor more than 1.12 at 38° C.

2nd: Not more than 3 per cent shall be insoluble by continuous hot extraction with benzol and chloroform.

3rd: On distillation which shall be made exactly as afterwards described, the distillate, based on water free oil, shall be within the following limits:

Up to 210° C., not more than 5%,
Up to 235° C., not more than 30%,
Up to 315° C., not less than 35% nor more than 70%,
Up to 355° C., not less than 65%.

4th: The specific gravity of the distillate between 235° C., and 315° C., shall be not less than 1.02 at 38° C., compared with water at 15.5° C. The specific gravity of the distillate between 315° C. and 355° C. shall be not less than 1.08 at 38° C. compared with water at 15.5° C.

5th: The specific viscosity at 82° C., when taken in an Engler viscosimeter shall not exceed 1.3. The term specific viscosity shall mean the number of seconds found for the sample tested divided by the number of seconds for water at 20° C., as given in the official certificate for the viscosimeter used.

6th: The oil shall not contain more than 3 per cent of water. Oil samples taken by the inspector from the treating tank during the progress of the work shall at no time show an accumulation of more than 2 per cent of foreign matter, such as sawdust and dirt, and due allowance shall be made for all foreign matter, either water or material insoluble in benzol and chloroform, by injecting an additional quantity of oil into the block.

Treatment.

The blocks shall be treated in an air tight cylinder, with the preservation heretofore specified. They shall first be subjected to live steam at a temperature between 220° F. and 240° F., for not less than two hours, after which they shall be subjected to a vacuum of

not less than twenty inches and held for at least ten minutes. The temperature of the blocks shall be maintained between 150° F. and 240° F. While the vacuum is still on, the preservative oil, heated to a temperature of between 180° F. and 200° F., shall be admitted, and the pressure gradually applied to the cylinder until a sufficient amount of the preservative oil has been forced into the block. After this, if so desired, a supplemental vacuum, with or without steam, may be applied. At the completion of the treatment each charge of blocks shall contain not less than an average of 18 pounds of water-free oil per cubic foot of wood. Not more than 10 per cent in excess of the amount specified shall be allowed. The blocks after treatment shall show satisfactory penetration of the preservative, and in all cases the sap-wood must be thoroly treated thruout. To determine this, at least 25 blocks shall be cut up from each charge, and if more than 4 per cent of the blocks show untreated sap-wood, the charge shall be retreated or rejected. After re-treating, the charge shall be again subjected to the same inspection.

The surface of the blocks after treatment shall be clean and free from any deposit of oil or foreign substance.

All blocks that are imperfect or that have been injured in the process of treating shall be rejected.

Handling Blocks After Treatment.

After the blocks have been treated and before they are laid, care must be taken to protect them as much as possible from drying out. They must at all times be closely piled when stacked on the street. All blocks must be thoroly wet, either while piled on the street before laying or while being laid, as directed by the Engineer.

Inspection.

All material and processes used in the manufacture of the blocks shall be inspected at the plant of the manufacturer, who shall equip his plant with all the necessary gages, appliances and facilities to enable the inspector to satisfy himself that the requirements of the specifications are fulfilled. He shall allow the inspector, or other authorized representatives, to inspect all material at all parts of the plant.

After delivery upon the street the blocks shall be subjected to a further inspection, and all imperfect blocks shall be rejected and removed from the street by the contractor.

Foundation.

The base shall be of concrete made in accordance with the specifications for concrete paving foundation and shall be*...... inches in thickness. At no place shall the surface of the finished concrete vary more than one-half inch from the given grade. The concrete foundation shall be cleaned and swept and shall be thoroly dampened immediately in advance of the spreading of the cushion course.

Cushion. (a) Mortar Bed.

Upon the concrete foundation shall be spread a layer of dry mortar one inch in thickness and made of one part of Portland cement and three parts of sand, the intention being to produce a granular mixture which may be raked to the desired grade. Only sufficient water shall be added to this mixture to insure a proper setting of the cement. The dry mortar shall be thoroly mixed and shall be spread in place on the foundation by means of a template immediately in advance of the laying of the blocks, to such a thickness that when the blocks are set and properly bedded in the mortar their tops shall conform accurately to the finished grade of the roadway.

Cushion. (b) Sand.

Upon the concrete foundation shall be spread a cushion of sand, one (1) inch in thickness. The sand cushion shall be struck by templates to a surface parallel to the grade and contour of the finished pavement in such a manner that when the blocks are set and properly bedded in the sand, the tops shall conform accurately to the finished grade of the pavement. The sand used in this cushion shall all pass thru a quarter (¼) inch screen and must contain between ten (10) and twenty-five (25) per cent of loam or clay.

Laying the Blocks.

Upon the bed thus prepared the blocks shall be carefully set with the fiber of the wood vertical, in straight parallel courses, generally

*NOTE.—The committee recommends that the concrete bed be at least 6 inches in thickness and under heavy traffic 8 inches to 9 inches in thickness.

at right angles to the curb, leaving a space next to the curb for the expansion joint*.

The blocks shall be laid by setting them closely together on the mortar bed and no joint shall be more than ⅛" in width. Nothing but whole blocks shall be used except in starting a course, or in such other cases as the city may direct; and in no case shall the lap joint be less than 2". Closures shall be carefully cut and trimmed by experienced men. The portions of the block used for closures must be free from checks or other fractures and the cut end must have a surface perpendicular to the top of the block and cut to the proper angle so as to give a close, tight joint.

After the blocks are placed they shall be rolled parallel and diagonal to the curb by a steam roller weighing between four and seven tons, until the surface becomes smooth and is brought truly to the grade and contour of the finished pavement. The rolling shall be completed before the mortar bed has set. All mortar that has set before the blocks are in place and rolled shall be discarded and replaced by fresh mortar.

Filler. (a) Sand.

After the rolling is completed, the joints between the blocks shall be filled by sweeping dry, clean sand into them, after which the surface shall be covered to a depth of about ½" with fine sand. This sand is to be left upon the pavement for such a time as may be directed by the city, after which it shall be swept up and taken away by the contractor.

Filler. (b) Bituminous.

After the rolling is completed, the joints between the blocks shall be filled with a bituminous filler, specified hereafter. The filler shall be brought to the proper temperature and poured into the joints; any filler on the surface of the pavemnt must be spread as thin as possible by means of squeegees.

After the joints are filled, as prescribed, the surface shall be completely covered by a thin coat of clean, coarse, dry sand, and a similar coating of sand shall be spread over the pavement, if required by the Engineer, before the acceptance of the pavement. The filler

*NOTE.—The committee recommends expansion joints ¾ inch in width at each curb for streets up to 30 ft. in width; 1 inch in width for streets between 30 and 50 ft. in width and 1½ inches in width for streets over 50 ft. in width.

used shall be a straight run residue obtained from the distillation of coal tar and shall comply with the following requirements:

1st. The melting point shall be not lower than 135° F., nor higher than 145° F.

2nd. It shall contain between 22 per cent and 37 per cent of free carbon insoluble in hot chloroform and benzol.

3rd. Its specific gravity at 77° F., shall not be less than 1.24 nor more than 1.32.

4th. The specific gravity of the distillate up to 355° C., shall not be less than 1.07 at 38° C., compared with water at 15.5° C.

Thermometers In Kettles.

The kettles in which the filler is heated on the street shall be equipped with approved thermometers, and the pitch shall be heated to a temperature of not less than 255° F., nor more than 300° F., and shall be poured when at a temperature between these limits.

METHODS OF SAMPLING AND TESTING PRESERVATIVE.

Sampling. Continuous Drip Sample.

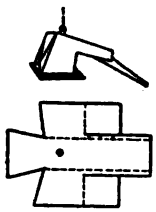
Wherever the oil is being loaded or discharged by means of a pump the following method shall be used:

The pipe line thru which the material is being pumped shall be tapped on the discharge side of the pump, preferably in a rising section of the pipe line. The sample shall be taken by means of a ½-inch pipe extending half way to the center of the main pipe, and the inlet of the ½-inch pipe shall be turned to face the flow of the liquid. This pipe shall discharge into a barrel or drum of 50 to 100 gallons capacity, and the plug cock regulated so as to secure a continuous uniform stream during the entire pumping of the shipment. The barrel, or preferably the iron drum, should be provided with a small steam coil, sufficient to keep the contents thoroly liquid. The temperature shall not exceed 120° F. The contents of the barrel or drum shall be very thoroly agitated and small samples for testing taken immediately. The amount of the drip sample collected shall be not less than 1 gallon to 1,000 gallons of material handled, excepting in the case of large boat shipments, where a maximum of 100 gallons will suffice.

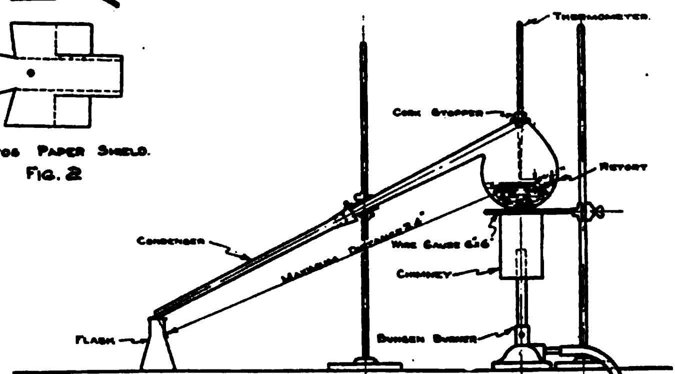
Storage Tank Samples.

In sampling from storage it is necessary to secure samples from different levels, and where possible this may be done by means of small outlet cocks at regular intervals from the top to the bottom of the storage tank. In such cases, about 1 gallon of tar or oil shall be drawn from each outlet cock and thoroly mixed and a portion taken for testing. The stream from each cock shall always be allowed to flow for sufficient length of time to empty the outlet pipe and nipple before commencing to collect the sample.

When tanks have no outlet cocks a vessel having a string attached to the cork may be lowered to measured depth representing a number of the different levels in the tank and the cork removed when the vessel has reached the proper level. These samples shall be combined for an average as above.



ASBESTOS PAPER SHIELD.
FIG. 2



STANDARD DISTILLATION TEST FOR CREOSOTE OIL
FIG. 1.

TESTING.

Distillation Test. Apparatus for Distillation Test.

(a) *Retorts*: This shall be a tubulated Jena glass retort of the usual form with a capacity of 250 to 290 c.c. The capacity shall be measured by placing the retort with the bottom of the bulb and the end of the off-take in the same horizontal plane, and pouring water

into the bulb thru the tubulature until it overflows the off-take. The amount remaining in the bulb shall be considered its capacity. (Fig. 1.)

(b) *Condenser Tube*: Any suitable form of glass tubing may be used; a convenient one is shown in Fig. 1.

(c) *Shield*: An asbestos shield as shown in Fig. 2, shall be used to protect the retort from air currents and to prevent radiation. This may be covered with galvanized iron, as such an arrangement is more convenient and more permanent.

(d) *Receivers*: Erlenmeyer flanks of 50 to 100 c.c. capacity are most convenient form.

(e) *Thermometers*: The thermometer shall be of glass, well annealed, and shall undergo no serious change at the zero point when heated up to 400° C. The space above the mercury column shall be filled with gas, either carbon dioxide or nitrogen, and the thermometer shall have an expansion chamber at the top.

The scale shall read from 0 to 400° C., in graduations of 1° C., which shall be etched on the stem.

The tip of the thermometer shall carry a ring for the purpose of attaching tags. The thermometer shall have the following dimensions:

Total length, 375 mm.; tolerance, 10 mm.
Bulb length, 14 mm.; tolerance 1 mm.
Distance from zero mark to bottom of bulb, 30 mm.; tolerance, 4 mm.
Scale length from zero mark to 400°C., 295 mm.; tolerance, 5 mm.
Diameter of stem, 7 mm.; tolerance, 1 mm.
Diameter of bulb, 6 mm.; tolerance, 1 mm.

When standardized the accuracy of such standardization should be as follows:

Up to 200°C.,..........................to the nearest 0.5°C.
200 to 300°C.,.........................to the nearest 1.0°C.
300 to 360° C.,........................to the nearest 1.5°C.

Assembling for Distillation Test.

The retort shall be supported on a tripod or rings over two sheets of 20-mesh gauze, 6 inches square. It shall be connected

to the condenser tube by a tight cork joint. The thermometer shall be inserted thru a cork in the tubulature with the bottom of the bulb ½ inch from the surface of the oil in the retort. The exact location of the thermometer bulb shall be determined by placing a central rule graduated in divisions not exceeding 1/16 inch back of the retort when the latter is in position for the test, and sighting the level of the liquid and the point for the bottom of the thermometer bulb. The distance from the bulb of the thermometer to the outlet end of the condenser tube shall be not more than 24 nor less than 20 inches. The burner should be protected from draughts by a suitable shield or chimney. (Fig. 1.)

Distillation Test.

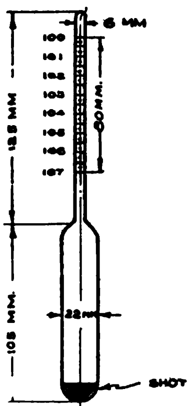
Exactly 100 g. of oil shall be weighed into the retort, the apparatus assembled and heat applied. The distillation shall be conducted at the rate of at least one drop and not more than two drops per second, and the distillate collected in weighed receivers. The condenser tube shall be warmed whenever necessary to prevent accumulation of solid distillates. Fractions shall be collected at the following points: Up to 210° C.; up to 235° C.; 235 to 315° C.; 315 to 355° C. The receivers shall be changed as the mercury passes the dividing temperature for each fraction. The last receiver shall be removed at 355° C., and drainage from the condenser, etc., shall not be considered as part of the fraction. For weighing the receivers and fractions, a balance accurance to at least 0.05 g. shall be used. During the progress of the distillation the thermometer shall remain in its original position. No correction shall be made for the emergent stem of the thermometer.

When any measurable amount of water is present in the distillate it shall be separated as nearly as possible and reported separately, all results being calculated on a basis of dry oil. When more than 2 per cent of water is present, water-free oil shall be obtained by separately distilling a larger quantity of oil, returning to the oil any oil carried over with the water, and using dried oil for the final distillation. A copper tar still is a convenient means of obtaining water-free oil.

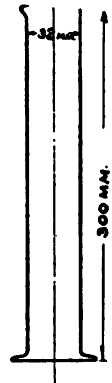
Specific Gravity Test. Apparatus for Specific Gravity Test.

(a) *Hydrometer:* The hydrometer shall be of the form and dimensions shown in Fig. 3.

(b) *Cylinder:* The cylinder shall be of the form and dimensions shown in Fig. 4.



HYDROMETER
FIG. 3.



CYLINDER
FIG. 4.

Specific Gravity Test.

A standardized hydrometer (Fig. 3) shall be used. A set of two ranges, 1.00 to 1.08 and 1.07 to 1.15 will suffice. The reading should preferably be taken at 38° C. (100° F.), because at this temperature almost all oils are completely fluid.

Before taking the specific gravity the oil in the cylinder should be stirred thoroly with a glass rod, and this rod when withdrawn from the liquid should show no solid particles at the instant of withdrawal. Care should be taken that the hydrometer does not touch the sides or bottom of the cylinder when the reading is taken, and that the oil surface is free from froth and bubbles. If the specific gravity is determined at a higher temperature than desired, correction should be made by adding 0.0008 to the reading for each degree Centigrade excess of temperature.

The sub-committee on wood block paving specifications for 1916 was instructed to gather data regarding specifications for oil and to present a report by February 1, 1916, if possible, to be printed in these proceedings, but the committee was appointed too late to complete its work and the proceedings are printed without the report.

Invitation was extended by the General Committee to those so desiring to send suggestions to the committee regarding provisions

desired in the specifications and the following are printed as being the suggestions received by the secretary up to February 1.

The three members of the new committee, E. R. Dutton, Chairman, A. W. Dow and H. Von Schrenk, recommend the specifications printed above.

P. C. Reilly recommends the following specifications for improved creosote oil as given at the end of his paper on page 210.

IMPROVED CREOSOTE OIL.

1. The oil shall be obtained by the distillation of coal tar and shall consist wholly of such distillate from coal tar as will comply with the following requirements:

2. The oil shall have a specific gravity of not less than 1.12 nor more than 1.14 at 38°C.

3. When the oil is subjected to distillation the distillates shall be as follows:

Distillate to 250°C. not over 1 per cent.
Distillate to 315°C. not over 15 per cent.
Distillate to 355°C. not over 40 per cent.

4. The residue above 355°C. shall be of a soft waxy nature at 25°C. When a drop is heated on white filter paper until it is absorbed by the paper, the spot formed, when viewed by transmitted light, shall be of a yellowish amber color.

5. When 25 grams of the oil are placed in an open pressed tin box approximately 2½ inches in diameter and ¾ inch deep and kept at a temperature of 49°C. (120°F.) it shall not lose more than 5 per cent by evaporation in 72 hours.

Tests.

The residue above 355°C. shall have a specific gravity of not less than 1.17 at 25°C.

The residue above 355°C. shall have a specific gravity of not less than 1.17 at 25°C.

The residue above 380°C. shall be of a soft waxy nature at 25°C.

The specific gravity of the fraction of the distillate 400°C. to 420°C. shall be not less than 1.12 at 38°C.

Sulphonation: When the following fractions of the distillate, 315°C. to 380°C. and 380°C. to 420°C., are subjected to the sulphonation test, neither of them shall contain more than 2 per cent of unsaponical oil in that particular fraction.

And I would suggest that any specification adopted should be so drawn as to exclude the use of coal tar or any other kind of tar from the preservative oil, and that the preservative consist of the highest grade of creosote oil.

W. H. Fulweiler, Chemist of the United Gas Improvement Co., proposes the following:

SPECIFICATIONS FOR PRESERVING OIL FOR USE IN WOOD BLOCK PAVING TREATMENT.

(1) Preservative oil shall be a product of water gas tar and be free from admixture of other crude or unrefined tars.

(2) The specific gravity at 38° C., compared with water at the same temperature shall be between 1.11 and 1.14.

(3) Material insoluble by hot continuous extraction with benzol or chloroform shall not exceed 2% by weight.

(4) Distillation to 210° C., shall not exceed 3% by weight.
Distillation to 235° C., shall not exceed 10% by weight.
Distillation to 315° C., shall not exceed 40% by weight.
Distillation to 355° C., shall not be less than 25%.

(5) Specific gravity of the distillate at 38° C., compared to 15.5° between 235° C., and 315° C., should not be less than .96, nor more than 1.00.

C. N. Forrest, Chemist of the Barber Asphalt Paving Co., forwards the following:

WOOD PAVING BLOCKS.

The representatives of The Barber Asphalt Paving Company have opposed the adoption of the specifications for wood paving blocks which were presented at the annual meetings of the American Society for Municipal Improvements in 1914 and in 1915, because that portion of such specifications which defined the character of

the preservative oil excluded materials of equal value, from a service point of view, which are more generally available than the specific oil called for.

This company is not a producer or distiller of tar of any kind, but is merely conducting a wood treating plant and purchases its oil or tar employed for saturating blocks and other timber entirely from outside sources. It has treated large quantities of wood blocks with coal tar oil of essentially the same character as that proposed in the specifications, as well as with water gas tar and with creosote and various other combinations which may have been called for. There is ample evidence of the sufficiency of other oils and tars than the one proposed, and in view of the impossibility of including all of them in a single specification without making its requirements too general to be effective, we, therefore, suggest that the requirements for the preservative be described under two separate heads as follows:

Type "A"—Coal-Tar oil.
Type "B"—Water-Gas Tar oil.

The preservative proposed for adoption by the committee is described as a coal tar oil, but could be a mixture of coal-tar and water-gas tar products as far as any of the tests mentioned in the specifications are concerned.

We do not criticise it as being unsuitable for the purpose, but water-gas tar is equally suitable and has the advantage of being more available and of lower cost to all concerned. We, therefore, propose the following specification for a preservative consisting of water-gas tar as an alternative of the coal tar preservative proposed by the committee:

The preservative shall be refined water-gas tar, and shall comply with the following requirements:

1. The specific gravity shall be not less than 1.12 nor more than 1.14 at 38°C., referred to water at the same temperature.

2. Not more than 2.0% shall be insoluble by hot extraction with benzol and chloroform.

3. On distillation which shall be made as hereinafter described, the distillate, based upon water-free oil, shall be within the following limits:

Up to 210°C., not more than 5.0%
Up to 235°C., not more than 15.0%
Up to 315°C., not more than 40.0%
Up to 355°C., not less than 25.0%

4. The specific gravity of the total distillate below 355°C., shall not be less than 1.00 at 38°C., referred to water at the same temperature.

5. The oil shall not contain more than 2.0% water and due allowance shall be made for all water and insoluble foreign matter it may contain by injecting a corresponding additional quantity into the blocks.

The Barber Asphalt Paving Company has treated millions of wood blocks with Water-Gas Tar of the above character and such blocks have been in practical service as long as coal tar blocks, as both kinds were introduced about ten years ago.

In 1908 about 22,000 square yards of water-gas tar blocks were laid in Boston, Pittsburg, Harrisburg, New London, Zanesville, and Havana, Cuba, and in subsequent years have been laid in quantity in a great variety of locations without a single failure. There is, therefore, indisputable evidence of the suitable character of the preservative described in our proposed specification for water-gas tar, and such a specification will not admit a tar of unsuitable character for the purpose, nor one which has been mixed with petroleum distillates or residues of any kind.

The above recommendations are made in response to a request of the Committee on Specifications at the Dayton meeting for such recommendations before February 1st, 1916.

J. W. Howard, Consulting Engineer on roads and pavements, New York City, recommends the following specification:

The preservative used must be a distillate creosote oil of above 1.03 sp. grav. at 38° C. (100° F.), containing less than 1% of matter insoluble in benzol by hot extraction. It shall be waterproof, antiseptic, containing at least 10% of crystallizable naphthalene, and at least 15% of the stable anthracene oil. When distilled as described in Bulletin No. 65, American Railway Engineering and Maintenance-of-Way Association, the total distillate on basis of

water-free oil up to 150° C. (302° F.), shall not exceed 1%; the total up to 200° C. (392° F.), shall not exceed 5%. The distillation shall be continued to 315° C. (600° F.), and the residue then remaining, when cooled to 25° C. (77° F.), shall be soft and easily indented with the finger. The creosote oil used shall be a distillate made from coal-tar or a combination of distillates from coal-tar and water-gas tar, provided the oil produced meets all the above tests of qualities needed for thoroly preserving wood.

BUSINESS PROCEEDINGS

OF THE

TWENTY-SECOND ANNUAL CONVENTION OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

Held at the New Miami Hotel, Dayton, Ohio, October 12, 13, 14, 15, 1915.

TUESDAY, OCTOBER 12, 1915.

MORNING SESSION.

The meeting was called to order by President Howell, at 10:00 *o'clock, a. m.*

PRESIDENT HOWELL: We will first listen to an address of welcome by Mr. Shroyer, Mayor of Dayton.

MAYOR SHROYER: Mr. Chairman and Gentlemen: I take particular pleasure in welcoming to Dayton the Twenty-second Annual Convention of the American Society of Municipal Improvements. This is an honor any mayor of any city in the United States might well be proud of. We, as city officials, fully appreciate the large problems you gentlemen are working out. A few years ago suggestions in the advancement of government or municipal improvements were largely put up in pamphlet form, which had a very large waste basket circulation. You know, and I know, that this has changed. You gentlemen are converting those beautiful theories into workable facts. We here in Dayton are doing well, and we are proud of it. Still, we have not reached the stage where we cannot improve further. We feel that Dayton will be materially benefitted by having this convention held in this city. It affords me extreme pleasure at this time to turn over to you the keys of the city. We sincerely hope that your stay with us will be profitable and pleasant, and that we may have the pleasure of having you in our city again. I thank you.

PRESIDENT HOWELL: We will now have the pleasure of listening to Hon. Henry M. Waite, City Manager of Dayton.

MR. WAITE: I know when you go to a convention of any sort it is usual to expect a facetious welcome, but I will not indulge in any of it. All I can say is, gentlemen, we are delighted to have you here with us. We have some things of interest. We believe that our government is of interest, and while there are many things that are not as they should be by any means, we feel that at least we are on the way. We do not quite agree with your honored president, who says that Newark, I believe, is the best governed city in the country. We question his right and authority to make any such statement. We want him to investigate very carefully what we have here, and we think he will go back with a changed view-point.

As I stated, we have not here all the things that we want, but we are accomplishing some things of interest. We have much yet to do; we are far from being satisfied at this time. We believe, however, that you will find in some of our accounting systems some little details that will be of interest, and we hope that you will take this occasion to look over them, and we court your suggestions. We are finding that by combining our feeble efforts with the experience of others, we get ahead much faster, which, of course, is the true intent of a gathering of this sort. We have arranged simultaneously with this meeting our budget exhibit, so that busy men like you can by taking a few minutes see by the eye many things which are being done, similar, of course, to other cities; some of the details being different.

I want to again express the appreciation of Dayton for your being here, and I sincerely trust and hope that this will be but the first. We are always very glad to see, not only conventions, but individuals. I thank you very much for this opportunity.

PRESIDENT HOWELL: We will now hear from Mr. Geo. B. Smith, Vice-President of The Greater Dayton Association.

MR. SMITH: Mr. Chairman, and Gentlemen of the Convention; There would be no excuse for an organization like the Greater Dayton Association appearing before you with a representative unless it had some connection with, some peculiar interest in things in which you are interested. In past years in Dayton we have had a Chamber of Commerce and associations of that sort, each one working in its own peculiar field. Then came a time for a different sort of organization. Things had happened in Dayton, a new city

government had been started, and it needed an organization to help it. We adopted this idea: Every measure of public improvement should have a well-selected, well-considered public opinion behind it. That was our business. We combined all philanthropic and semi-philanthropic organizations, chamber of commerce, and organizations of that character, and organized a membership of over six thousand men and women who pledged themselves to stand behind the city government. And in behalf of that organization I come to you this morning with greetings and the hope that you will study our method of dealing with the things in which you are peculiarly interested. We had at one time various things to contend with; we had a great flood, and we have had fires, and we also had politicians. We have organized a movement for better things. We took the affairs of government away from the politicians who constantly pestered us, and we placed the government in the hands of our citizens, business men, men who knew how to conduct business. At the same time we did not take away the power, we did not seek to control or diminish it, but we seek only to help them, help our city manager and his staff, help the city commissioners and their departments by suggestions, by co-operation, by whatever plan may be suggested by them or by us. So on behalf of these six or seven thousand men and women of Dayton, I take pleasure in welcoming you to our city, and I hope you will find it an ideal place, and that you will come again. That is the business of the Greater Dayton Association.

PRESIDENT HOWELL: The response to the addresses of welcome will be made by Mr. Morris R. Sherrerd, of Newark.

MR. SHERRERD: Mr. President and Gentlemen of the Convention: It gives me very great pleasure to answer and accept on behalf of our Society the cordial welcome which we have received from the officials of Dayton. It strikes me that the meeting of this Society, composed so largely of engineers, in a place like Dayton, which has shown by its energy and by its progressive spirit the advantages of a new form of government, is opportune. This same spirit was also shown at the Boston meeting by the activities of the representatives of Dayton's city government and by the success of its representative in getting this Society to come to Dayton at this time—that this convention is here I believe carries with it in a measure a message to the Society. The whole country is watching

the development of the manager plan, of modified commission form of government, and we are now being given the opportunity to see its workings at first hand, and I believe that the message which Dayton presents to us is, to go back to our own cities, and, insofar as we may make this method of city government applicable at home in the way of improvements over what we now have, make an effort to work along the lines of the establishment of some similar form of government. The message that is of further use to the engineer is, it seems to me, that here is given a recognition of the engineer in executive office. It is a recognition which most of us have felt the engineer deserved from his close contact with the business relations of the work which he has in hand. We must admit that if the government of a city can in its business management eliminate politics and get better results by reason of that elimination, it is certainly a step in the right direction. Therefore, gentlemen, I think that I speak for the Society in expressing the thanks of the American Society of Municipal Improvements to our friends in Dayton, and I want to express the hope that we may take away with us the spirit of Dayton rising, phoenix-like, out of its difficulties as it has done in its recovery from the flood disaster and in dealing with the problem of control of the floods. Certainly, this calamity has been, in a measure, a blessing in disguise. I think it has brought to the foreground the necessity of the business management in city government, and it certainly has brought this beautiful city of Dayton national recognition for the spirit which it has displayed in overcoming such a disaster as the flood of 1913. Therefore, I say Mr. President, on behalf of our Society, that we are and will be benefited by our visit to this beautiful city, and we thank the city for inviting us here.

PRESIDENT HOWELL: The next order on the program is the President's address.

PRESIDENT'S ADDRESS.

By WILLIAM A. HOWELL.

Gentlemen of the Convention and Visitors from the City of Dayton—It is with a feeling of profound satisfaction that we have assembled in this beautiful city to hold our Twenty-second Annual Convention—in the city bearing the name of one of New Jersey's illustrious sons, Jonathan Dayton, who with Madison, Hamilton,

Franklin and George Washington signed that wonderful paper, the Constitution of the United States. In March, 1913, the sympathy of the civilized world was given to Dayton, sorely stricken by one of the most disastrous floods in the history of the Central West. The indomitable spirit of your people was first displayed in the gigantic task of removing the wreckage from the streets and houses. This work was accomplished in an incredibly short time. The next step taken by the citizens of Dayton was to raise a large sum of money to make a careful study of the flood problem with a view of forever preventing a repetition of such a great disaster. We are informed that mass meetings were held; some 22,000 subscribers in four days subscribed the great sum of $2,150,000 to a Flood Prevention Fund. This flood prevention fund was promptly collected, and a suitable portion was immediately used to employ eminent hydraulic engineers, familiar with flood prevention problems. We are further informed that, as a result of the study of the situation by these eminent consulting engineers, a system of seven huge detention basins or dry reservoirs was recommended. These detention basins, when completed, will retard the excess flow of water in times of extreme floods, so that below the dams the rivers will never flow over their banks. Concrete outlet tunnels thru each dam will permit the normal flow to pass. This great engineering project, the estimated cost of which will be about $17,000,000, is being carried out under the provisions of the Conservation Act of Ohio, one of the Legislative enactments of 1914. The Miami Conservation District includes within its limits parts of ten counties.

The flood problem solved, it is related that the people of the awakened city started a campaign for a new City Charter and a better local government. On January 1, 1914, we are informed, the new Commission Government of the City of Dayton with a prominent municipal engineer as General Manager, was launched on its career, and the attention of the entire country was attracted to the notable event.

The American Society of Municipal Improvements completes the twenty-first year of its existence with this Convention. Our first convention was held at Buffalo, N. Y., in 1894. At that time modern wood block pavements as laid to-day were not in existence; the Warren Brothers Bitulithic pavement had not been introduced. The concrete base under standard pavements, altho in use in most

large cities, was far from being in general use. Cement grouted granite pavement was unknown, except possibly in Worcester, Mass. The day of the septic tank had not yet arrived. Municipal electric lighting was still in an elementary stage. The question of perfecting legislation for the prevention of pollution of streams adjoining municipalities, had not reached even the academic stage of discussion. The conservation by the various states of the supply of potable water within their borders had not at that time taken any definite form. In many of the larger states, the State highways were neglected and the legislative financial aid furnished was meagre and inadequate. Commissioners for the care of shade trees, of playgrounds and for city planning and designing were practically unknown thruout the length and breadth of the land. With reference to city planning prominent individual members of this Society have manifested great interest in the advancement of matters connected with its development, including the advocacy of the exceedingly important principle of excess condemnation in connection with the opening of important streets and avenues in large cities.

The work of the American Society of Municipal Improvements during the past few years has been exceedingly valuable to the country at large. With the union in 1913 of the sister Society for Standardizing Paving Specifications, we have received a goodly number of municipal engineers of high standing from cities not previously identified with our Society. Specifications were adopted at the Boston Convention as follows: for Stone Block Paving, Brick Paving, Cement Concrete Paving, Broken Stone and Gravel Roads, Sheet Asphalt Paving and Sewer Construction. The only specifications not adopted at Boston and which will come up for adoption this year at Dayton, will be the specifications for Bituminous Concrete Paving and Wood Block Paving. With the completion of these specifications, there will be available for use in every little town or hamlet in this broad land the careful and painstaking work of the municipal experts of this country, who, with no hope of any pecuniary reward, have given their best efforts to accomplish results of immeasurable value to the city population of America.

The relative importance of the city and the farm has changed completely since the early days of this country's history. In 1790 there were probably not more than twenty cities in America having a population of 5,000 or more. In 1910 there were 1,217 such

The population of the 100 leading cities of the United States, 0, amounted to more than 24 million people, or about 26 't of the total population. The population of the 1,217 reviously referred to represents a total of 38 million people, more than 41 per cent of the total population of 1910. Add to this number the vast multitudes who work in the large cities during the day and dwell in the country after their day's work has ended, and it is no exaggeration to state that at least one-half of the total population of the United States reside in cities. The city population of Rhode Island represents 98 per cent of the total population; of Connecticut 80 per cent; of Massachusetts 87 per cent; of New York 77 per cent; of New Jersey 70 per cent; of Pennsylvania 55 per cent; of Illinois 57 per cent and of Ohio 52 per cent. It does not require much argument after glancing at these figures to realize the great importance of good government for cities. The office of mayor in New York City, Chicago, or Philadelphia outranks in importance the governorship of New York, Illinois, or Pennsylvania. For many years American cities have been groping after better government. The Commission form of municipal government has taken a firm hold in this country and many cities have adopted that form of local government. This it is adaptable to cities having a large native born population and where the population does not exceed 150,000 has been demonstrated rather conclusively. Municipal charters modeled after the New York City pattern are worthy of study by cities ranging in size from 300,000 population to a million or over. That widespread interest in municipal government will in time develop some system of educational training similar to the German system for the ambitious young man who desires to follow a municipal government career, seems very probable. The young German student in civics first takes a four years' course in law at one of the great universities where he is thoroly instructed as to municipal, state and national law. He then secures a position in the city of Stuttgart, Wuertemburg, for example, in the finance department. After two or three years experience at Stuttgart he secures a more important position in Dresden, Saxony, for instance, where he broadens his knowledge of municipal administration. In time, after several transfers and promotions, he becomes a well rounded official, familiar with all forms of municipal administration; in other words he is an expert mayor or burgomaster. He is seldom a native of the city whose government he administers. He is

chief executive simply by reason of his record in many cities as an expert administrator.

These conventions of technical societies are to a large degree educational. An exchange of ideas of men from different portions of our land cannot but be helpful to all. Methods of practice in municipal engineering in Dallas, Texas, may be adaptable to Grand Rapids, Michigan, or Wilmington, Delaware.

With an interesting program for our Convention, punctual attendance at the various meetings is urgently requested. That a larger number of members participate in the discussion of the various papers is to be greatly desired.

PRESIDENT HOWELL: The next thing on the program is the Secretary's Report.

REPORT OF THE SECRETARY.

By CHARLES CARROLL BROWN.

The Secretary presents his report for the year from Oct. 1, 1914 to Sept. 30, 1915, as follows:

By the method of keeping the numerical count of members, in classes with municipal and associate members as well as delegates and representatives, it has not been possible to balance the account exactly and the following table shows the count of individuals on Sept. 30, 1915, correctly, tho it may not check exactly across the preceding three columns; the first column, taken from last year, not having been kept in that way. Hereafter the count will be kept individually so that it will be sure to balance and firms holding associate memberships but not having individual representation will be counted as individual members, but if so represented, their representatives will be counted and not the firm or corporation. Cities not appointing delegates will not be counted as members. When delegates are appointed they will all be counted as individual members and not the city itself.

	In 1914	Admitted during year	Lost during year	Membership Sept. 30, 1915
Active	406	43	100	339
Affiliated	9	2	1	11
Associate	81	20	6	106
Totals	496	65	107	456

Included in the 406 active members in the first column were 67 delegates of 22 municipal members. There were also 8 municipal members who did not appoint delegates. Of the 43 admitted during the year 2 are delegates of 2 municipal members.

The 81 associate members in 1914, consisted of 81 representatives of 61 associate members. There were also 11 associate members who had not designated their representatives. The 20 associate members added during the year represent 14 new associate members and one of the 11 unrepresented associate members mentioned in the preceding sentence.

The losses of active members from all sources consist of the following:

Dropped for non-payment of dues	55
Resigned	12
Died	2
Municipal delegates dropped by failure to reappoint	31
Total....	100

One affiliated member resigned.

Losses of associate members were as follows:

Representatives of associate members resigned	2
Unrepresented associate members resigned	1
Mail was returned undeliverable from	3
Total....	6

On September 30 of this year we had 321 active members and 18 municipal delegates representing 10 cities, making the total of 339 shown in the table.

We have 11 affiliated members.

The 106 associate members represent 76 firms and individuals.

The experience of the early days of the Society as to memberships by cities is being duplicated in our current history and the number of delegates from municipal members appointed for this year has fallen

off materially from last year. Many of these delegates continue as individual members. There are many individual members whose dues are paid by the cities employing them tho they are not classed as delegates of municipal members, the designation not being very popular with them. Only 14 cities appointed delegates this year as compared with 23 of last year.

The members who have died, so far as reports have reached the Secretary, are: Samuel L. Cooper, Yonkers, N. Y. and J. E. Putnam, Rochester, N. Y., and their names have been referred to the Obituary Committee for proper action.

It will be noted that much of the individual loss in members is due to the failure of municipal members to appoint delegates, tho the number dropped at the last convention for non-payment of dues netted 55 after some of those reported had paid up their delinquent dues. The list was well cleaned up last year, and no delinquents are presented for action by the Board this year.

The following cities have credits from the A. S. P. S. for the number of delegates paid for by that Society in the amalgamation not yet taken up by appointment of delegates:

Boston, Mass.	4	delegates
Chicago, Ill.	4	delegates
Columbus, O.	4	delegates
Lynchburg, Va.	1	delegate
Norfolk, Va.	3	delegates
Pasco, Wash.	3	delegates
St. Louis, Mo.	1	delegate
Salisbury, N. C.	2	delegates
Salt Lake City, Utah	1	delegate
South Omaha, Nebr.	3	delegates
	26	

The following table shows the monthly receipts during the year, classified as to source, and the remittances of the Secretary to the Treasurer. The account runs from October 1, 1914 to September 30, 1915.

Month	Rect. Nos.	Proceedings A. S. M. I.	Proceedings A. S. P. S.	Specif.	Misc.	•Advts.	Membership Dues Affil.	Membership Dues Active	Membership Dues Assoc.	Membership Dues Munic.	Remittance to Treasurer. Dates	Remittance to Treasurer. Amts.
1914 Oct.	3025-3030	7.00					5.00	5.00	20.00		9/30/15	37.00
Oct.	3031-3101	4.00	10.00			5.00		205.00	190.00	5.00	10/31/14	419.00
Nov.	3102-3108	7.00	5.00		125.77	24.00			25.00		11/30	186.77
Dec.	3109-3127	21.00	5.00	2.00	1.00			95.00	10.00		12/31	134.00
1915 Jan.	3128-3177	5.00	10.00	14.51		20.00	5.00	165.50	10.00		1/31/15	227.01
Feb.	3178-3250			30.62				290.00		5.00	2/28	325.26
Mar.	3251-3297		5.00	19.00			5.00	112.50	25.00	50.00	3/31	216.50
Apl.	3298-3353	8.00		34.25			7.60	40.00	230.00	40.00	4/30	359.85
May	3354-3386	2.00		11.00				77.50	100.00		5/31	190.50
Jun.	3387-3394			2.25				32.50			7/1	34.75
July	3395-3412		5.00	6.00				55.00			8/3	66.00
Aug.	3413-3463	48.00		93.05		160.00	10.00	60.00	15.00		8/31	386.05
Sept.	3464-3531	*45.00		28.86		158.40	5.00	110.00	42.50		9/25	387.76
Oct.					3.79						10/11	3.79
Totals		147.00	40.00	241.18	130.56	367.40	37.60	1245.00	667.50	100.00		2976.24

Since the books were closed $127.51 have been received which will be included in the report for next year.

The receipts during 1915 were less than receipts during 1914 by $401.48. Since the receipts for 1914 included $738.68 due to the amalgamation with the A. S. P. S., the receipts due to the operations of the A. S. M. I. are really $337.20 greater than those of 1914.

The expenditures are classified as follows:

Office.

Stenographer	$540.00	
Stamps	178.84	
Express and Freight	33.89	
Telegrams	5.69	
Supplies and Miscellaneous	8.95	
		$767.37

Printing.

Programs 1914 convention	$37.08	
Letter heads and envelopes	92.25	
Halftones and cuts	106.07	
5000 Constitution Booklets	66.25	
Reprinting and Binding Specifications	171.60	
800 Proceedings	1439.95	
	———	$1913.20

Miscellaneous.

Reporting 1914 convention	$87.50	
Traveling expenses (Secretary)	69.45	
Convention expense	37.00	
Treasurer's bond	7.50	
Distributing Proceedings	156.00	
Envelopes for specifications	10.45	
Copyright for specifications	1.13	
Secretary's salary	300.00	669.03
Total...........		$3349.60

The totals of receipts and expenditures show an excess of the latter amounting to $373.36. The expenditures are greater than last year mainly on account of two items, the larger size of the Proceedings and the editions of the Standard Specifications printed during the year. The larger size of the volume of Proceedings was due mainly to the printing of the Specifications in full, since this year they were all revised with the aid of the members of the A. S. P. S. It will probably not be necessary to print them again in full, so that this excess in cost of the Proceedings is extraordinary and need not be expected again. The increased expense extended, of course, to such items as the cost of distributing the Proceedings.

The cost of printing the Standard Specifications has been collected together and shows as follows:

201 pages in the Proceedings @ $1.30..................	$261.30
Reprints of the Specifications	171.60
Envelopes for distributing	8.25
Stenographer's time, postage and express for the distribution of Specifications separately (estimated)	35.00
Excess in cost of distributing Proceedings on account of larger size, about	55.00
Total........	$531.15

The proceeds from the sale of copies of the specifications were $241.18. This sum more than pays for the printing and distribution of the separate editions of the Specifications, ($214.85 as above) leaving the excess of cost on their account only that of the 201 pages of the Proceedings devoted to them, or $316.30, a sum which approximates the deficit for the year.

There are supplies of all the adopted specifications on hand which can be sold, any changes made at this convention being printed on slips and pasted in the proper place, so that probably the whole expense of the specifications will be met from the sales. The only specifications requiring reprinting will probably be those not adopted last year which are up for action this year.

The cost of printing and distributing the Proceedings and advance papers for 1914 collected from the above was as follows:

Printing	$1439.95
Cuts	106.07
Sending out	156.00
Sending out advance papers (est.)	32.00
	$1734.02

The receipts on account of the Proceedings were:

Advertising	$318.40
Proceedings A. S. M. I.	147.00
Proceedings A. S. P. S.	40.00
	$505.40

There is still due from advertisers $78.00 which will doubtless be collected. Counting this in, the Proceedings cost $1150.64 more than the receipts from them. Advertising receipts were less because advertising was hard to get this year.

There are a few miscellaneous unpaid accounts for Proceedings and Specifications in process of collection, amounting to $51.75.

The following members have been admitted during the year. This list does not include those admitted at the convention of 1914, whose names will be found on pages 731 and 732 of the Proceedings for 1914:

Active.

Beggs, James L., Commissioner of Streets and Public Improvements, Kansas City, Kansas.

Bryson, Carl H., City Engineer, Lima, Ohio.

Cooper, C. Winston, Engineer for Winston County and Fayetteville, North Carolina.

Craver, H. H., Chief Chemist, Pittsburgh Testing Laboratory, Pittsburgh, Pa.

Darby, C. A. City Engineer, Sabetha, Kans.

Devlin, F. A., City Engineer and County Surveyor, Newton, Kans.

Durham, Henry Welles, Consulting Engineer, New York City.

Foreman, Alvah E., Assistant City Engineer, Victoria, B. C., Canada.

Fulton, D. F., City Engineer, Yonkers, N. Y.

Hayler, Guy Wilfred, Senior Draftsman, Chief Engineer's Office, South Park Commission, Chicago, Ill.

Heebink, G. E., City Engineer, Beloit, Wis.

Hohenstein, Aug., City Purchasing Agent, St. Paul, Minn.

Hughes, Hector James, Prof. of Civil Engineering, Harvard University, Cambridge, Mass.

Kindrick, A. H., City Engineer, McAlester, Okla.

McCarthy, John, City Engineer, Wymore, Nebr.

McLean, G. T., City Engineer, Astoria, Ore.

Meckley, Earle W., Principal Assistant Engineer, Allentown, Pa.

Moore, John W., Consulting Engineer for Madison, Ind. and Chicago Jct. O., Indianapolis, Ind.

Morgan, R. D., City Engineer, Temple, Tex.

Nicholson, Victor, Engineering Chemist, city of Chicago, Ill.

Ogier, Jas. W., Assistant Engineer, Baltimore, Md.

Parobek, Anastasius, City Chemist, Trenton, N. J.

Roberts, H. N., Jr., City Engineer and Superintendent of Water Works, Longview, Texas.

Russell, G. Raymond, City Engineer, Rosedale, Kansas.

Sammelman, Sylverius, In charge of Street Design, Dept. of the President, St. Louis, Mo.

Schmidt, H. H., Chief Engineer, Bureau of Highways, Brooklyn, N. Y.

Struthers, David L., City Engineer, Wilmington, N. C.

Tomlinson, W. S., Principal Assistant Engineer, Shand Engineering Co., Columbia, S. C.

Ulrich, Edmund B., City Engineer, Reading, Pa.

Wooley, W. Thomas, City Engineer, Syracuse, N. Y.

Affiliated.

Hamilton, Farrar P., Paving Engineer, Southern Pine Association, New Orleans, La.

Schrenk, Hermann von, Consulting Timber Engineer, St. Louis, Mo.

Associate.

Atlantic Refining Co., A. F. Armstrong, Highway Engineer, Philadelphia, Pa.
Atlas Portland Cement Co., Wilbur T. Challar, Manager Road Dept., New York City.
Cleveland Trinidad Paving Co., M. F. Bramley, President, Cleveland, Ohio.
Harris Granite Quarries Co., George R. Collins, Managing Director, Salisbury, N. C.
International Clay Products Bureau, Benjamin Brooks, Engineer, Kansas City, Mo.
Jennison-Wright Co., H. J. Jennison, President, Toledo, Ohio.
Prudential Oil Corporation, S. J. Dalzelle, Chief Chemist, Baltimore, Md.
Southern Paving Brick Manufacturers' Association, John W. Sibley, Secretary-Treasurer, Birmingham, Ala.
Union Oil Co. of California, San Francisco, Calif.
U. S. Asphalt Refining Co., Geo. B. McGrath, Southern Sales Manager, Norfolk, Va.

The following members have withdrawn during the year by resignation:

Active.

Anderson, C. G., Moline, Ill.
Blanchard, A. C. D., Winnipeg, Man.
Clark, Alfred, Concord, N. H.
Jaques, W. H., Little Boar's Head, N. H.
Keyser, Geo. D., Blowout, Idaho.
Koiner, C. W., Consulting Engineer, Pasadena, Calif.
Mueller, A. C., Mayor, Davenport, Iowa.
O'Neill, Jos., Leavenworth, Kans.
Randolph, Robert Isham, Consulting Engineer, Chicago, Ill.
Sherman, Chas. W., Consulting Engineer, Boston, Mass.
Waugh, R. D., Winnipeg, Man.
Whitney, H. L., City Engineer, Beverly, Mass.

Affiliated.

Datz, L. C., New Orleans, La.

Associate.

Power Specialty Co., New York City.
The Texas Co., L. W. Kemp, Houston, Tex.
Warren Bituminous Paving Co., W. G. Mackendrick, Toronto, Can.

Mail addressed to the following has been returned undeliverable:

Continental Construction Co., W. B. Spencer, New York City.
Iola Portland Cement Co., Bob Burns, Asst. Sales Mgr., Dallas, Tex.
Ockander Bros., Frank Whitley, Hillsboro, Tex.

One county and a number of cities have asked permission to use the Standard Specifications in their work:

Greene County, Tenn.
Lafayette, Ind.
Miami, Fla.
New Britain, Conn.

The following were elected to membership at the convention of 1915 or made application at the convention and were elected immediately after it, and are not included in the preceding account of membership, which closed Sept. 30.

Admitted at the Convention.

Municipal.

Pasadena, Calif., Municipal Lighting Dept., C. W. Koiner, Mgr.

Active.

Belt, Edwin K., City Engineer, 525 Woodward Ave., Kalamazoo, Mich.
Cummin, Gaylord C., City Manager, Jackson, Mich.
Eichelberger, F. O., City Engineer, 915 Cottage Grove Ave., Dayton, O.
Hoopes, Edgar M. Jr., Chief Engineer, Wilmington, Del.
Horner, W. W., Engr. of Design Dept. of Sewers and Paving, 325 City Hall, St. Louis, Mo.
Huston, R. C., Consulting Engineer, 1010 Falls Bldg., Memphis, Tenn.
Hutchinson, A. E., Albuquerque, N. M.
Laberge, F. C., Consulting Engineer, 30 St. James, Montreal, Canada.
Lindsley, Henry D., Mayor, Dallas, Texas.
Linsley, Chas. W., Commissioner of Works, 52 Utica St., Oswego, N. Y.
Moseley, Hal, City Engineer, Dallas, Texas.
Near, W. P., City Engineer, St. Catharine, Ont., Canada.
Pierson, Frank W., Street Commissioner, Wilmington, Del.
Root, Joseph E., Asst. Engr., Div. of Sewerage, 3436 Lyleburn Pl., Cincinnati.
Ryan, Patrick H., Comm'r. Board of Street and Water Comm'rs., City Hall, Newark, N. J.
Sarver, Wm. Edward, City Engineer, Canton, Ohio.
Smith, F. L., Asst. Engr., Rochester, N. Y.
Stern, Eugene W., Chief Highway Engineer, 21st Floor Municipal Bldg., N. Y.
Sweetman, Emmett F., City Engineer, Urbana, O.
Wise, Colin R., City Engineer, 301 Gregory St., Passaic, N. J.

Affiliated.

Greenough, Maurice Brown, In charge of Highway Engineering, Case School of Applied Science, Cleveland, O.

Associate.

J. H. Arnold, 17 Battery Place, New York City, Repr. Indian Refining Co.

Granite Paving Block Mfrs. Assoc. of the U. S., 54 Devonshire St., Boston, Mass. Zenas W. Carter.

Jackson Pipe Co., Chicago, Ill.,
Wm. O. Tracy, Chicago Club, Chicago, Ill.

J. Leopold & Co., 233 Broadway, New York City.
J. L. Leopold.

Donald McNeil Co., Jenkins Arcade Bldg., Pittsburgh, Pa.
Donald McNeil.

Metropolitan Paving Co., 11 Pine St., New York City.
Hugo Reid.

Rockport Granite Co., Rockport, Mass.
C. Harry Rogers.

ADMITTED SINCE THE CONVENTION—APPLICATIONS FILED IN OCTOBER.

Active.

Aldrich, Elbert C., City Engineer, Auburn, N. Y.

Anderson, Frederick J., City Engineer, City Hall, South Bend, Ind.

Bingham, Clarence A., General Manager, Norwood, Mass.

Blair, Alexander, City Engineer, Summit, N. J.

Boynton, R. H., City Engineer, Frankfort, Ind.

Brandon, Walter W., Supt. of Water Works, Anderson, Ind.

Brower, Irving C., Commissioner of Public Works, Evanston, Ill.

French, R. D., Consulting Engineer, Montreal, Canada.

Funk, Elmo A., City Engineer, City Hall, Anderson, Ind.

Jennings, F. W., Village Engineer, Bixley, 509 Hartman Bldg., Columbus, Ohio.

Lawrence, E. A., City Engineer, Westerville, 509 Hartman Bldg., Columbus, Ohio.

Mercier, Paul E., Acting City Engineer, Montreal, Canada.

Mitchell, Karl M., City Manager, Sherman, Texas.

Morse, Howard Scott, Director, Cincinnati Bureau of Municipal Research, 804 Neave Bldg., Cincinnati, O.

Pollard, Seabury G., Consulting Engineer, 3422 Burch Ave., Cincinnati, Ohio.

Sheridan, Lawrence V., Bureau of Municipal Research, Room 908—261 Broadway, New York City.

Soutar, Frank F., Civil Engineer, Sioux City, Iowa.

Tuska, Gustave R., Consulting Engineer, 68 William St., New York City.

Affiliated.

Bureau of Municipal Research, 261 Broadway, New York City.

Associate.

Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.,
E. L. Walcott.

Pioneer Asphalt Co., Lawrenceville, Ill.,
H. B. Pullar.

Standard Oil Co. of La., New Orleans, La.
J. S. Helm.

These lists do not include new representatives or withdrawals of representatives of Associate Members.

PRESIDENT HOWELL: We will now have the Treasurer's Report.

TREASURER'S REPORT.

By WILL B. HOWE.

Receipts.

Balance from 1914	$1,853.65
November 5, 1914, Charles C. Brown	419.00
December 7, 1914, Charles C. Brown	186.77
January 23, 1915, Charles C. Brown	134.00
February 4, 1915, Charles C. Brown	227.01
March 6, 1915, Charles C. Brown	325.26
April 5, 1915, Charles C. Brown	216.50
May 8, 1915, Charles C. Brown	359.85
June 12, 1915, Charles C. Brown	190.50
July 5, 1915, Charles C. Brown	34.75
August 5, 1915, Charles C. Brown	66.00
September 4, 1915, Charles C. Brown	386.05
September, 27, 1915, Charles C. Brown	389.76
September 30, 1915, Charles C. Brown	37.00
October 11, 1915, Charles C. Brown	3.79
	$4,829.89

Disbursements.

November 5, 1914, The Neerman Press, programs	$37.08
November 5, 1914, Central Law Reporting Co., reporting sessions	87.50
November 5, 1914, Charles C. Brown, Sec'y., convention expenses	69.45
November 5, 1914, Charles C. Brown, Sec'y., office expenses	91.58
November 24, 1914, Morrill & Danforth, treasurer's bond	7.50
December 7, 1914, Charles C. Brown, Sec'y., office expenses	48.26

December 10, 1914, The Neerman Press, letter heads and contracts	16.50
December 14, 1914, Printing Arts Co., halftones and cuts	35.51
January 23, 1915, C. P. Lesh Paper Co., envelopes	8.25
January 23, 1915, The Neerman Press, booklets and letter heads	74.50
January 23, 1915, Charles C. Brown, Sec'y., office expense	101.16
February 4, 1915, S. E. Tate Printing Co., specification reprints	156.60
February 4, 1915, Charles C. Brown, Sec'y., office expense	60.00
March 6, 1915, Printing Arts Co., halftones for proceedings	8.80
March 6, 1915, Indianapolis Electrotype Co., electrotypes	4.40
March 6, 1915, F. B. Neff Printing Co., committee letter heads	38.75
March 6, 1915, Cameron & Bulkley, committee stationery	5.00
March 6, 1915, Charles C. Brown, Sec'y., office expense	58.19
April 7, 1915, O'Daniel & Kessing Engraving Co.	54.51
April 7, 1915, F. B. Neff Printing Co., stationery	6.00
April 7, 1915, Charles C. Brown, Sec'y., office expense	56.20
May 10, 1915, F. B. Neff Printing Co., changing dates letter heads	3.75
May 10, 1915, Cameron & Bulkley, committee letter heads	5.00
May 10, 1915, Charles C. Brown, Sec'y., office expenses	56.21
June 8, 1915, O'Daniel & Kessing Co., cuts for proceedings	2.10
June 8, 1915, Indianapolis Electrotype Foundry Co., remounting and trimming cuts for proceedings	.75
June 8, 1915, Charles C. Brown, Sec'y., office expense	51.67
June 8, 1915, Charles C. Brown, Sec'y., salary account	100.00
July 7, 1915, Charles C. Brown, Sec'y., office expense	51.65
August 6, 1915, F. B. Neff Printing Co., letter heads	4.50
August 6, 1915, Charles C. Brown, Sec'y., office expense	51.20
September 4, 1915, S. E. Tate Printing Co., specifications	15.00
September 4, 1915, S. E. Tate Printing Co., proceedings	1,439.95
September 4, 1915, S. E. Tate Printing Co., expense sending out proceedings	156.00
September 4, 1915, F. B. Neff Printing Co., stationery	3.50
September 4, 1915, Charles C. Brown, Sec'y., office expense	100.18
September 14, 1915, Charles C. Brown, Sec'y., salary account	200.00
September 28, 1915, W. K. Stewart, clasp envelopes	2.20
September 28, 1915, Charles C. Brown, Sec'y., office expense	79.20
Total disbursements	$3,349.60
Balance October 1, 1915	1,476.50
	$4,826.10
Oct. 11, 1915, Charles C. Brown, error in express bill	3.79
	$4,829.89

Respectfully submitted,

W. B. HOWE,
Treasurer.

The two reports were duly received and referred to the Finance Committee for audit and report.

PRESIDENT HOWELL: The only other committee on the program ready to report is the Committee on Committees, which will be ready in a few minutes. We will therefore pass to the next order, the selection of a Nominating Committee and a Committee on Resolutions.

The following were then placed in nomination as members of the Nominating Committee and elected: Mr. Giddings; Mr. Norton, of Buffalo; Mr. Sherrerd, of Newark; Mr. Fisher, of Rochester; and Mr. Folwell, of New York.

PRESIDENT HOWELL: A Committee of three on Resolutions is now to be nominated.

The following were then placed in nomination and elected: Mr. Briggs, of Erie; Mr. Sprague, of Pittsburg; and Mr. Preston, of Dallas.

PRESIDENT HOWELL: If Mr. Folwell is ready, we will now have the report of the Committee on Committees.

MR. FOLWELL: Mr. President, possibly a word of explanation as to the purpose of this committee might be desirable for those who were not at the convention last year. It had been suggested that there had been in the past more or less confusion among the committees themselves, more or less questioning by members of newly appointed committees as to what their duties were, and the question was raised also as to whether the entire ground which this Society should cover was being adequately covered by the committees which we then had. The President, therefore, on a vote of the Society, appointed a special committee to consider this matter during the year and report at this convention recommendations as to any revisions which they thought desirable of the apportioning of the work among committees; and also to prepare what we might call a set of instructions to the committees which would give any newly appointed committee an idea of what they were expected to do, thus, (as one purpose) saving the secretary considerable correspondence in writing personal replies to questions of newly appointed chairmen of committees.

I might add that our constitution gives a list of the regular committees which are to be appointed by the Society, so that if the Society decides to accept this report and to add the new committees

suggested and change the two titles suggested, it will be necessary to do that to-day, so that a suggestion to amend the constitution in that respect may be submitted to-day. Otherwise, it can not be acted upon at this convention.

REPORT OF SPECIAL COMMITTEE FOR REVISING AND STANDARDIZING COMMITTEE WORK.

A PRESCOTT FOLWELL, Chairman.

The special committee appointed last year to define and co-ordinate the duties of the standing committees and prepare a set of instructions for the several committees have exchanged ideas on the subject during the year, and beg to present the following recommendations:

In view of the fact that streets—surface, sub-surface and super-surface—seem to be the subject of greatest interest to the society, and that paving proper occupies the attention of the committee to the exclusion of other matters connected with city streets, it is recommended that the general subject of streets be divided among two committees in addition to those already provided. The committee on sewers deals with one feature of sub-surface construction, and the committee on street lighting with one of the super-surface features, but there remains the consideration of sidewalks, curbs and gutters (for which a special committee was appointed last year) and the general designing of streets—the harmonizing of all portions and functions of the street surface and the structures under and resting on it; and all of that phase of municipal work coming under the general head of "city planning." We would, therefore, suggest that the various features of municipal work having to do with streets, be apportioned among the several committees as follows:

(1) Committee on Street Paving—Roadway pavements on streets and roads. Materials, construction, repairing and maintaining.

(2) Committee on Sidewalks and Street Design—Materials, construction, repairing and maintaining of sidewalks, curbs and gutters. Cross slopes of these; grades at intersections; crowning of roadways; street grades; culverts, drainage, etc.; sidewalk vaults; wire conduits; street signs, posts and other obstructions—in fact, everything having to do with the physical treatment of a street and not covered by committees (1), (3), (4), (5) and (6).

(3) Committee on City Planning—the general laying out of a city into streets, parks, etc. Physical, social, aesthetic and legal principles. Location and width of streets, size of blocks, etc.

(4) Committee on Parks and Parkways—the designing, constructing and maintaining of parks as located on the city plan. Shade trees, planting strips and vegetation generally along city streets.

(5) Committee on Street Lighting—Location of lights, kinds of lamps, principles of illumination and everything having to do with the general subject of street lighting.

(6) Committee on Traffic and Transportation—traffic census records and methods. Street railways and other public conveyances.

In the above it will be noticed that, in addition to introducing two new committees, the name of the committee on Park Development and Maintenance has been changed to "Committee on Parks and Parkways"; the idea being to suggest by the title that the work of the committee should include municipal shade trees and shrubbery wherever found within city limits. The committee on Traffic on Streets has been changed to "Traffic and Transportation," with the idea of widening the scope of this committee to include consideration of street railways and other public conveyances, and even the broad one of transportation between cities and their residential suburbs.

The Committee on Water Works and Water Supply would devote its attention to the general subject indicated by the title, including, of course, water purification.

Similarly, the committee on Sewerage and Sanitation would deal with everything relating to sewerage and sewage treatment, board of health work and other features of municipal sanitation.

The committee on Street Cleaning and Refuse Disposal would consider collection and disposal of all kinds of refuse, appliances used in collection and disposal plants, the organization of forces, etc.

No change is suggested for either title or duties of the committee on Government and Finance. As heretofore, this committee would be engaged largely with the consideration of city charters, ordinances, the preparation of budgets, city finances, etc.

No change is suggested for the committee on Standard Forms, nor for those on Convention Papers and Convention Arrangements.

The committee on Standard Specifications has done excellent work and the more strenuous part of this is now reaching its end; but it seems desirable to continue the committee as a standing committee in order that the standard specifications of this society may be kept up-to-date and modified from time to time as may seem necessary, to have them conform to the latest developments in street paving.

It might be well at this point, however, to call attention to the purpose for which this committee was originally provided. To give the fullest opportunity for the discussion of technical details among the experts most interested in them and to save the time of the convention, many of whom are not interested in such technical discussion of details in any one case, it was the intention in establishing the system of committees on standard specifications to place the original formulation of the specifications and any proposed changes in them in the hands of the sub-committees, the members of which were to be selected for their special qualifications in their respective subjects. Any one desiring a hearing on any provision or amendment would be expected to take it up with the chairman of the sub-committee. The reports of the various sub-committees are then to be taken up with the general committee, and the habit has been to begin the meetings for this purpose on the day preceding the first day of each convention. These committee meetings are open to all interested and any one who desires to have the action of the sub-committee reviewed can bring the matter in which he is specially interested to the attention of the general committee at such meetings. The specifications are still subject to discussion and amendment when they are presented to the convention, but it was the idea, in establishing the system outlined, that most of the discussion of technical details, which are at the same time important, time-consuming, and of immediate interest to but a small portion of the convention audience, should be held in the less formal and smaller gathering about the table of the general committee; so that, even if appeal is taken to the convention, most of the ground will be cleared before the report is presented and the discussion on the floor, if one is necessary, can be directed at the particular points of difference.

The original idea of the society in providing a committee on Convention Exhibits also has apparently been forgotten. It appears to the committee that the early idea was better than the practice which has developed during the past two or three years. It was

originally provided that this committee consist essentially of associate members, to be selected by the associate members, but to contain two active members who had power to veto any action of the committee so that it could take no action which would be opposed to the dignity or interest of the society. We would suggest that this idea be re-established and that three associate members be elected each year by the associate members present at the convention.

Instructions to Committees.

There is apparent a tendency in many of the committees to gradually develop a method of procedure or field of discussion which was not the original intention of the society in establishing the committee, and it seems desirable, therefore, to adopt, as a permanent record, a statement of the purposes for which the several committees are continued. A more important reason, however, for issuing instructions to committees is the fact that, as the chairmen of committees are quite generally changed from year to year, each begins his work more or less in the dark as to just what constitute the duties and aims of that committee. For this reason, this committee suggests the following instructions; and also that, when they may have been modified and adopted by the society, copies of them be printed by the Secretary and that in the future a copy be sent to each member of each committee as soon as practicable after the appointments have been made by the President. The instructions should, of course, be kept up-to-date by changes and additions made necessary by actions of the society in appointing new committees or modifying the duties of existing ones.

General Duties of Committees.

As already defined by the Constitution, the duties of committees, (except those which are specifically described in Article 6, Section 6 of the Constitution) consist in preparing reports and obtaining papers to be presented at the annual meetings of the society.

The report of a committee should be one which will present the general progress made in the art and science during the year; also mention of specific constructions, patent decisions, discoveries, important books and papers, new materials, machinery, or contrivances worth mentioning; and in general, a review of progress of any and all kinds made during the year in the particular field

allotted to the committee. This information would be most valuable if the facts have been well digested by the committee and presented to the society in a connected statement following some logical train of thought, and not merely as a series of clippings from technical papers and other sources. It is recommended that, in obtaining special information for their report, each committee make use of the Clearing House of Information conducted by the Secretary. In obtaining information in this way, the several chairmen should take up the matter with the Secretary not less than three months before the convention, in order that the Secretary may, so far as possible, include all the inquiries in one communication to the several city officials from whom the information is to be obtained, thus reducing to a minimum the effort and expense involved.

It is recommended that, in addition to a general report on the entire field covered by a given committee, the committee select some one feature to be given special and more extended attention in its report; this naturally being a subject which is receiving special attention at that particular time and concerning which, therefore, there is special need that the members be given the latest and most complete information available.

In obtaining papers for the annual meeting, instead of asking broadcast for papers on any subject, the society would be better served if each committee were to select subjects upon which it is desirable to have papers prepared, and endeavor to obtain discussions of these subjects from those best qualified to write them (whether members or not). The subject or subjects chosen would ordinarily be those selected by the committee as the principal feature of its own report.

At the same time, the committees should make an effort to encourage the younger and newer members of the society to present any information which they may have on details of practice, with the idea of encouraging them to take an active part in the society and to retain their interest in the same. However, the committee should keep in mind the interests of the society as a whole and eliminate, as far as possible, discussions of well-known ideas or descriptions of common-place work which would take up the time of the society with little resulting benefit. (In order to provide that members who have something to say, but who may not have been asked by any committee to prepare a paper, may be encour-

aged to present the information to the society, it should be generally understood and definitely announced that such papers are urgently invited; which announcement would properly come from the Secretary and President of the society.)

It is desirable to have as many papers as possible distributed among the members in advance of the convention, and committees are requested to urge those who consent to prepare papers to have them in the hands of the committee by such date as the Secretary may fix as necessary for this purpose.

Every paper should be passed upon by the committee in whose field it would naturally come, and if accepted by such committee, should then be transmitted to the committee on Convention Papers, of which the Secretary of the society is chairman by provision of the Constitution.

The discussion in convention which is brought out by a paper is frequently more valuable than the paper itself from an informative point of view, and is especially so as giving an interesting and live convention. This idea should be kept in mind in selecting subjects and approving papers to be read before the society. In the case of some papers, such as those which contain tables and statements more or less burdened with statistics, it would be well for the committee to go carefully over the paper and note such matter as could not be readily appreciated by an audience but only when read from the printed page, and to request the author either to omit this in reading the paper before the society (the matter, of course, to be published in full in the Proceedings,) or to prepare a brief statement for such oral presentation which will give the gist of the information contained therein.

Authors should be requested to include in their papers all which they desire to say upon the subject, or at least to put the same in writing to accompany the paper; there being two reasons for this, one, that there may be no question as to the matter being published in the Proceedings exactly as the author intended it; and the other because perhaps the majority of men, in making extemporaneous statements before a convention, are likely to unnecessarily occupy a much greater length of time in explaining themselves than if they had previously put the same idea in writing.

Both committees which solicit papers and also the committee on Convention Papers should endeavor to eliminate from all papers

matter which is apparently presented with the sole object of advertisement; but this should not be taken to exclude statements containing information which would be of benefit to the society, merely because they describe or commend some patented or commercial article.

As a general thing, a short paper full of meat is much preferable to a long one, and condensation of papers should be encouraged, but not to the point of lessening their intelligibility. There are, of course, exceptions, such as a comprehensive paper covering a wide field and endeavoring to sum up all available information on a subject; but generally speaking, 2,500 to 5,000 words is an excellent length for a paper, or at least for that part of it which is to be read aloud at the meeting.

The following outlines as definitely as seems practicable the subject matter which each of the several committees is supposed to have under its consideration. Where a certain topic overlaps two fields, or where there is uncertainty as to which of two committees should discuss it, the matter may be submitted to the Secretary for decision; or each committee should feel free to discuss it, since an occasional duplication would be preferable to entire neglect of any important topic.

The subject matter assigned to each of the several committees is generally described in the following:

(Following this would be placed the descriptions given in the first part of this report as to the range of topics assigned to each of the committees.)

A. Prescott Folwell, Chairman,
Chas. C. Brown,
Edward S. Rankin.

MR. SHERRERD: I move that the report of the Committee be received and adopted by the convention as presenting the list of standing committees to be used by the Society, and that the instructions as contained in the Committee's report be sent out by the Secretary to the several committees appointed thereunder.

Seconded by Mr. Kingsley, and carried.

MR. FOLWELL: The adoption of this report I suppose means the adoption of these various committees. To make that effective it

will be necessary that some one present to this meeting a proposed amendment to the constitution. I understand it requires a formal notification to the Society that they will be called upon at a later time in the convention to vote on the change in the constitution. So, to comply with that provision of our constitution, I would state to the convention that it is the intention to ask the convention at a later date to vote upon the change in the list of committees to conform to the report as read.

MR. TRIBUS: Mr. President, I move that the Executive Committee be instructed to prepare the proper form of amendment of the constitution, so that it can be adopted later, Mr. Folwell being on the Executive Committee.

The motion was adopted.

MR. SHERRERD: Mr. President, I would move that the selection of the place of meeting be set down as a special order of business at 11 o'clock tomorrow morning, and also the election of officers at the same time.

The motion was duly seconded, and adopted.

MR. WARREN: Mr. President, those of the members of this Society who were in attendance at the convention last year will well remember Mr. Atwood, the chairman of the entertainment committee at that convention. Mr. Atwood came to this convention, intending to attend thruout the deliberations. He, this morning, received a telegram that the mother of his wife, whom the ladies attending the convention will well remember as a prominent member of the ladies' entertainment committee, died, and Mr. Atwood was called home. I move you, sir, a vote of sympathy to Mr. Atwood and his family, and that the President and Secretary be directed to join the name of the Society to a telegram of condolence and sympathy.

The motion was duly seconded, and adopted by a rising vote.

Adjournment to 2 o'clock p. m.

AFTERNOON SESSION

The Convention was called to order by President Howell at 2.15 p. m.

PRESIDENT HOWELL: The first paper on the program this afternoon is one by Mr. B. F. Miller, City Engineer, Meadville, Penn.

MR. MILLER: I want to say that my paper is more in the nature of a report. I was asked by Mr. Fetherston to prepare some data and statistics regarding garbage collection and disposal, which might lead to a discussion of the subject productive of some good.

The paper will be found on page 7, *and discussion on page* 27.

PRESIDENT HOWELL: One paper on the program whose author found he was unable to come to the convention, and who therefore sent his paper to be read, is that of Mr. E. R. Conant, Chief Engineer, of Savannah. Mr. Conant contributed a paper last year which was very favorably received, and I requested him to supplement that paper with one this year, as to how that plant of his has operated. He very kindly consented, and I will now read his paper on "The Operation and Efficiency of the High Temperature Destructor Plant at Savannah, Ga."

The paper will be found on page 16, *and discussion on page* 27.

PRESIDENT HOWELL: Mr. J. E. Barlow's paper on "Garbage Disposal in Dayton" will now be read.

MR. BARLOW: I think every city sooner or later will meet this garbage disposal question, and we can say from experience that it is a pretty knotty problem.

In the course of the reading of the paper Mr. Barlow presented views thrown on a screen illustrative of the present garbage disposal plant under construction by the city of Dayton.

The paper will be found on page 1, *and discussion on page* 27.

PRESIDENT HOWELL: We will have next a paper by Dr. D. Frank Garland, Director of Public Welfare, Dayton, O., on "Public Welfare Thru Legislation."

DR. GARLAND: Mr. President, Ladies and Gentlemen: I have made a little change from the wording that you have in your program, meaning however the same thing—"The Law and Public Welfare."

The paper will be found on page 320.

PRESIDENT HOWELL: We will next have a paper by Mr. A. F. Macallum, City Engineer, Hamilton, Ontario—"Some Notes on Waterworks Reconstruction."

Mr. Macallum presented with his paper a number of photographs illustrative of the subject discussed.

The paper will be found on page 73.

MR. FOLWELL: The Executive Committee this morning requested me to draw up formally the amendment recommended by the Committee on Committees in the report read this morning, and the exact form of the amendment which will be voted upon later on in the convention will be as follows:

Resolved, that the list of standing committees of this Society as contained in the Constitution, Art, IV, Sec. 4, be amended as follows: Add committees to be called Committee on Sidewalks and Street Design and Committee on City Planning. Change title of Committee on Park Development and Maintenance to Committee on Parks and Parkways; also change title of Committee on Traffic on Streets to Committee on Traffic and Transportation. No action, I think, is necessary on that at the present time.

I omitted to state this morning, which I very much regret, that the other members of the committee which prepared the report are Mr. Charles Carroll Brown, our Secretary, and Edward S. Rankin, and equal credit is due to those gentlemen for drawing up that report.

PRESIDENT HOWELL: This will conclude the session, and we will stand adjourned until tomorrow morning at 9 o'clock.

WEDNESDAY, OCTOBER 13, 1915.

The Convention was called to order by President Howell at 9:15.

PRESIDENT HOWELL: One of the gentlemen who has a paper is obliged to leave, and he has asked to have his paper taken up at this time. It is "The Relation Between Specifications, Tests and the Uses of Material," by Benjamin Brooks, Engineer of the International Clay Products Bureau, Kansas City, Mo.

The paper will be found on page 313.

PRESIDENT HOWELL: I will now read a paper by our old friend and past president, Charles H. Rust, City Engineer, Victoria, B. C., on "The Sooke Water Supply."

The paper will be found on page 84.

PRESIDENT HOWELL: We had several papers read yesterday on garbage disposal plants, and perhaps it would be interesting to have some discussion on the one presented by Mr. Miller, for instance.

The papers will be found on pages 1, 7 *and* 16, *and the discussion on page* 27.

PRESIDENT HOWELL: If there is no further discussion, we will proceed to the next paper, which is "Flood Prevention," by Mr. E. A. Deeds, Chairman, Board of Directors of the Miami Conservancy District, Dayton, Ohio.

The paper will be found on page 375.

MR. REIMER: We have listened to a most inspiring and able address by this gentleman, and each one of us must have been inspired with the magnitude of this great work. I think few of us realized until we saw these pictures and heard the remarks of this gentleman, the stupendous undertaking which confronted Dayton, Ohio, and as I listened to it I realized that no work has exceeded this work in magnitude. The work of building the Panama canal, in my estimation, taking into consideration the population and area affected, is far overshadowed by this great work; and I think it would be fitting for this Society, as we are assembled here this morning, and as we have all felt the inspiration of the great work which is to be done here—greater to humanity, I say, than any other work which I have ever heard of—it will be fitting that we tender to this gentleman a rising vote of thanks for this presentation and I so move you.

The motion was seconded and adopted by a rising vote.

PRESIDENT HOWELL: It was decided yesterday to have as a special order at 11 o'clock to-day the report of the Committee on Nominations:

REPORT OF COMMITTEE ON NOMINATIONS.

Your Committee on Nominations submit the following report:

For President—
A. F. Macallum of Hamilton, Ontario.

For First Vice-President—
N. S. Sprague of Pittsburg, Pa.

For Second Vice-President—
John B. Hittell of Chicago, Ill.

For Third Vice-President—
Elbridge R. Conant of Savannah, Ga.

For Secretary—
Charles C. Brown of Indianapolis, Ind.

For Treasurer—
William B. Howe of Concord, New Hampshire.

Finance Committee—
Edward S. Rankin of Newark, N. J.
Matthew Brown of Emporia, Kansas.
F. J. Cellarius of Dayton, Ohio.

The Committee desires to state that the retirement of Mr. E. L. Dalton from the office of Vice-President, is caused by his ceasing to be a city official and his entering into the field of contracting.

Fred Giddings,
Geo. H. Norton,
A. Prescott Folwell,
M. R. Sherrerd.

MR. GIDDINGS: Mr. President, I move the adoption of the report and that the President cast the vote of the Society for the gentlemen named.

The motion was duly seconded and adopted unanimously and President Howell declared the persons named duly elected as the respective officers of the Society.

PRESIDENT HOWELL: The time has now arrived to decide upon a place of meeting for next year.

MR. KINGSLEY: Mr. Chairman, this Society has depended for a good many years on the active co-operation of some of its members who have stayed with it thru thick and thin. Amongst the most active members—yes, perhaps we might say the most active members—have been a delegation who have come to every convention for ten or fifteen years at least, from two to a dozen strong. We have depended upon this one bunch, in times when the Society was almost on the ragged edge, to tide us over. We could always depend upon the members of this one crowd of good, loyal, faithful men to carry us thru, to work for us day and night, thru thick and thin. Several years ago it was suggested that we meet in Newark, New Jersey. The Newark bunch did not want us. They had no hotel. We promised three years ago, and again two years ago, that whenever Newark called, we would go. Gentlemen, to-day Newark is asking for the convention. To-day Newark tells us that their new hotel is ready, and in behalf of Newark, in behalf of Morris Sherrerd, in behalf of our honored President, in behalf of Past President Owen and the others from Newark, I wish to nominate Newark, N. J. I want to read these telegrams to the Society:

"In the name of the city of Newark, N. J., I cordially invite your Society to add to the pleasure of our 250th Anniversary by holding your next convention in this city.

THOS. L. RAYMOND,
Mayor."

"By resolutions the Board of Street and Water Commissioners has instructed me to extend to your Society a most cordial invitation to hold your 1916 Convention in Newark, N. J., and advise you that all your sessions can be held in the City Hall. The Board will also charge itself with all other necessary arrangements.

AL. SWAIN,
Acting Clerk."

"Fifteen hundred business men, members of the Board of Trade of the City of Newark, extend a cordial greeting. The Two Hundred and Fiftieth Anniversary of the Founding of Newark will be celebrated in 1916. The citizens of Newark would esteem it a great honor to have the Convention of the American Society of Municipal Improvements held in this city next year.

JAMES M. REILLY,
Secretary."

Gentlemen, I move that we accept the invitation extended by virtue of these telegrams, but above all the invitation of our own Newark bunch, to meet with them next year.

MR. ARTHUR R. DENMAN: In supplementing Mr. Kingsley's most courteous and generous remarks with reference to Newark, New Jersey, and the attitude of its delegations to this and the other conventions of the A. S. M. I. heretofore held, we, of Newark, thank him most appreciatively. It is a privilege indeed to say a few things calculated to be of interest concerning that great city and its various enterprises that have engaged the attention and efforts of its people and their public officials by way of further introduction to it and them and invitation to its precincts for the holding of our 1916 Convention, and for better acquaintanceship with its ideals as a mighty workshop, in what it has achieved and is achieving as a developing municipality along the lines of modern progress. Besides this especially emphasizing the 250th anniversary of the founding and settlement of "our town on the Passaick" by those of Branford and other towns of Connecticut, to be observed next year and for which much preparation is being made.

It isn't often that I ask your indulgence to hear remarks from one whom I might call an outsider, in the sense that I am not an engineer, but answer to the profession of law. But be assured that it is a great pleasure to meet with you annually as I have had that honor for the last few years, and to become acquainted with the spirit of the engineering fraternity and of this Society in particular.

When a youngster I was put at a trade which related closely to a great machine shop, and while my particular branch of the business was with the pattern shop yet, as you know, when it came to practical work it became our task to assimilate information and instruction from the workmen of both shops, and having been brought up with a clean bib and tucker, I naturally looked on anyone with a smudgy face and soiled clothing as being out of my set, callow boy that I was. It was not long before I became acquainted with the men around me, and discovered to my surprise that there were men and men; some were of course of the plainer sort, laborers doing the laborer work. But one day I was sent down to the end of the dock to fit a templet in one of the marine engines in a vessel lying there, when I came in contact with a young man

who was in working clothes and smudgy face and who had a dab of grease here and dirt there; but I happened to notice that he was a straight, upstanding fellow. Having a question to ask, I asked it of him. And would you believe it, that young man looked me squarely in the eye and told me just what I wanted to know about that engine, and I became impressed with the fact that he was every inch a sailor and every inch a gentleman and that it was high time that I revised my opinions and set about learning of men and things.

Then came professional life with its duties in the office and at the bar where my vision was brightened and broadened by contact with minds of different culture, but with the stoop of shoulder and careless dress of the professional man, and then official responsibility where was made the acquaintance of yet other professional men, to wit, the civil engineer with his characteristic smudge and boots; and do you know that I have so completely reversed my boyhood's opinions that I begin to doubt professionalism without its professional marks, especially the smudge of the engineer, which seems to be his particular trade mark. It does seem to be his badge of competency to go around in hickory and brogans covered with mud; for so they appeared in Panama, Mexico, United States and Canada where I have seen them.

And so, when one comes to these clean-clothes-and-dress-up occasions you know he has difficulty in distinguishing who are engineers and who are the other fellows until he gets to know them pretty well. Now, it so happens that I know you gentlemen a good deal better than you know me, because most of you are men of national reputations, some even of international repute, and while I can call you by name you probably don't know me at all.

But, none the less, gentlemen, I am proud to be identified with you, if but locally from the city I call my own, and cannot suffer this occasion to pass without speaking in its behalf; hence I stand before you.

The city from which I come is a great workshop. Every engineer loves to get into the workshop. I do not know what your individual talent may be. Are you a hydraulic engineer? If so, we will show you one of the handsomest, most complete and efficient water conservation plants in this country. We will show you where it starts, how developed, impounded, utilized as a gravity supply of 50,000,000

gallons daily and how it is delivered in the great city of Newark, with its 400,000 people, practically pure at the tap. Sometimes I think our neighbor across the Hudson has been borrowing some of our ideas in its new gravity supply first impounded in and then tunnelled from the Catskill mountains, for that is our system and has been for many years.

It may be that you are interested in sanitary engineering and drainage. If yes, we have one of the largest drainage tunnels at present under construction, which I am sure you will be delighted to investigate. Away down under the ground 30 or 40 feet may be seen in preparation and almost completed a large drainage tunnel which is designed to care for a territory inhabited by something like a million of population. If interested in marine engineering, that is, docks, ship channels, reclamation projects and the like, I do wish you would come and see us on the 20th of this present month, because then the curtain will be rung up on what we have accomplished; a municipal dock some 4,500 feet long, projecting with an angle in it right out into Newark Bay, with an area behind it of 150 acres of reclaimed swamp and morass filled by dredging from the Bay and having an excellent foundation for factory, warehouse and railroad buildings and other industrial development. We also have something like 200 miles of paved streets, the best in the country and I know of no city that can surpass us in that branch of civic work. If interested in street pavements, as I know you are, come and see us for we have all kinds. Many of you fellows from the West and Southwest might want to see a cobble pavement, the pavement of our daddies. Newark has 'em and will be pleased to take you a ride over 'em in a wagon without springs that you may get full benefit.

But we have the other varieties too: Smooth brick and wood block which is our latest venture. Broad street is a street of 132 feet average width and over two miles long and has a wood block pavement that will make your eyes shine.

Now come anyway whether for business or pleasure, for among other things we have a large and splendid fire-place. That is, not in Newark exactly, but just at Newark's door; it is really a part of Newark and we will possibly annex it some of these days. Some call it New York City. Anyway it is just across the Hudson; you step into the Hudson Tube and there you are in the midst of the great metropolis with its splendid harbor and all the rest of it.

We have been listening with much interest to discussions here about the magnificent work of flood water disposal. We will show you more salt water in two minutes than the whole of the Ohio Valley has contained of fresh water since it was created. When you get to know salt water and the ozone of the ocean, its sports and resorts, my word for it, you will have no further use for the fresh article unless properly treated, of course.

Dayton is the home of the flying machine. A great deal of fame has come to it because of Wright Brothers' enterprise and inventions. This is as it should be, and the city does well and wisely to nurture and bring to success that great industry. And here lies a distinction between Dayton and Newark, because for the last few years Newark, New Jersey, has been spending thousands of dollars and doing a whole lot of work in exterminating its flying machines. Until recently and ever since Newark was founded 250 years ago there have been swarms of flying machines hovering over and around it, which have given it a great deal of notoriety.

Now these machines that you are making here to-day are being developed along destructive lines and are said to have been used, much to our regret, in the conduct of the war abroad. But if you want to see a real, genuine, fully developed war proposition in the shape of a flying machine with striped legs and body go on the Newark meadows where they sit on the trees and bark and many of them weigh a pound.

Such was our flying machine, and you must come soon if you want to see him in his native heath, for like "Poor Lo" he is fast vanishing forever. However I give assurance that there is no real danger to life, limb or happiness from this source, whatever our jealous neighbors may say about us.

Now gentlemen, the telegrams from our Mayor and Trade Board are cordial and sincere in extending the invitations for the next Convention to be held in Newark and they but echo the welcome that every citizen of our 400,000, will extend to you. You have always honored Newark by giving to it exalted positions in your councils and in your organization. Newark now desires to honor you. So come with your spendid Society and give Newark the benefit of seeing what engineers look like when they are together and dressed up in their sunday-go-to-meetin's and get into action wisely discussing things.

A whole city extends to you in all cordiality the right hand of fellowship and that city is Newark, New Jersey.

MR. NORTON, of Buffalo: On behalf of the delegation from Buffalo, I wish to say that we came with an invitation for this Society to meet in Buffalo, not only on behalf of the delegates and members from that city, but on behalf of the Mayor and the Chamber of Commerce. When I came here, I saw that Newark was it, and so it gives me great pleasure to second the nomination for Newark.

The convention unanimously accepted the invitation to meet at Newark, N. J., in 1916.

PRESIDENT HOWELL: The hour of adjourment has now arrived, and we will stand adjourned until 8 o'clock this evening.

EVENING SESSION

The Convention was called to order by President Howell at 8.15 *p. m.*

PRESIDENT HOWELL: The first matter this evening will be the report of the Committee on Street Paving, by Frederic A. Reimer, Chairman.

The report will be found on page 94.

PRESIDENT HOWELL: A number of papers were left over from this morning, and I will now call on Mr. W. H. Taylor, Jr., City Engineer, Norfolk, Va., to read his paper on "Asphalt Repairs for Small Municipalities."

The paper will be found on page 110.

PRESIDENT HOWELL: The next will be a paper "Joint Fillers for Granite Block Pavements", by C. D. Pollock, Consulting Engineer, New York City.

The paper and discussion will be found on page 96.

PRESIDENT HOWELL: The next paper will be one on "The Types of Bituminous Construction and Their Limitations", by Mr. Francis P. Smith, of New York City.

The paper and discussion will be found on page 120.

PRESIDENT HOWELL. The next is a paper by R. M. Cooksey, of Baltimore, on "Napped or Re-cut Granite Paving as Used and Constructed in Baltimore", but as he is not present and the paper is printed in the advance papers we will read it by title.

The paper will be found on page 107.

PRESIDENT HOWELL: The next will be a paper on "The Proper Oil for Treating Wood Block for Paving", by P. C. Reilly of Indianapolis, illustrated with slides:

The paper will be found on page 210 *and the discussion on page* 244.

MR. SHERRERD: Mr. President, I move than the consideration of the report of the Committee on Standard Specifications be set down as a special order of business at the beginning of to-morrow afternoon's session.

The motion was duly seconded, and carried.

PRESIDENT HOWELL: We have three or four wood block papers, and as the hour is getting late we will have these papers read, and then have the discussion on them all afterward. The next paper will be by Mr. J. W. Howard, on "Wood Block Pavements with Special Reference to Economic and Efficient Wood Preservatives."

The paper and discussion will be found on page 238.

PRESIDENT HOWELL: The next paper is on "Oil Specifications for Creosoted Wood Block", by Herman von Schrenk, of St. Louis.

The paper will be found on page 178 *and the discussion on page* 244.

In the absence of the author and because it was printed in the advance papers, Mr. Dutton's paper on "Some Experiences in Creosote Wood Block Paving", was read by title.

The paper will be found on page 167.

THURSDAY, OCTOBER 14, 1915.

MORNING SESSION.

The meeting was called to order by President Howell at 9:00 o'clock a. m.

PRESIDENT HOWELL: The first thing on the program this morning will be the reading of the report of the Committee on Standard Tests for Bituminous Materials, by Prof. Blanchard, of New York City.

REPORT OF COMMITTEE ON STANDARD TESTS FOR BITUMINOUS MATERIALS.

In accordance with the resolution adopted at the 1914 Convention, President Howell appointed Arthur H. Blanchard, Felix Kleeberg, Lester Kirschbraun, Francis P. Smith and Linn White members of a committee "whose function it shall be to invite and direct the co-operation of all chemists dealing with bituminous materials for the purpose of further standardizing present methods of testing and for the purpose of encouraging and developing additional methods and appliances for valuating paving bitumens."

Since the appointment of the committee active work has been undertaken along the following lines: (a) Tabulation of information pertaining to the present status of the details of all tests of bituminous materials used by national societies, state highway departments, and municipalities; (b) investigation of the value of tests proposed by various chemists and engineers; (c) formulation of plans for effectively securing the co-operation of all chemists and engineers and the adoption of standard details of tests by state and municipal highway departments.

All members of the Society are earnestly requested to actively cooperate in the work of the committee by the submission of descriptions of methods of testing used by them, new methods for the determination of the physical and chemical properties of bituminous materials, and statements relative to difficulties encountered with the methods of testing in general use.

Respectfully submitted,

Arthur H. Blanchard, Chairman,
Felix Kleeberg,
Lester Kirschbraun,
Francis P. Smith,
Linn White.

On motion, duly seconded, the report was accepted.

PRESIDENT HOWELL: The next are the paving brick papers. First, "A Study of Brick Pavement Construction," by Will P. Blair, Secretary of the National Paving Brick Manufacturers' Association.

The paper will be found on page 133 *and the discussion on page* 162.

PRESIDENT HOWELL: The next paper is on "Vertical Fiber Brick Pavements," by Mr. A. D. Duck, City Engineer, Greenville, Tex. Mr. Brown will kindly read the paper.

The paper will be found on page 153 *and the discussion on page* 162.

PRESIDENT HOWELL: The last brick paper is on "Vitrified Brick Construction of Streets and Roads," by William C. Perkins, Chief Engineer, Inspection Department of Dunn Wire-Cut-Lug Company, Conneaut, Ohio.

The paper will be found on page 142 *and the discussion on page* 162.

PRESIDENT HOWELL: Mr. Blair will now show a few of his celebrated slides, after which the discussion will be open on all these papers.

The discussion will be found on page 162.

PRESIDENT HOWELL: We will now start the work down on the program for this morning. We will first have the report of the Committee on Sewerage and Sanitation, by Mr. George H. Norton, Chairman, Buffalo, N. Y.

The report will be found on page 32.

PRESIDENT HOWELL: The next paper on the program will be presented by that loyal brother of this Society whose membership runs back, I think, almost to the organization of the Society in 1884, my friend Mr. T. Chalkley Hatton, on "The Pioneer Plant for Treating Sewage by Activated Sludge Process."

The paper and discussion will be found on page 41.

PRESIDENT HOWELL: We will now proceed to the next paper, "Re-aeration as a Factor in Self-Purification of Streams," by Prof. Earl B. Phelps. We will read that by title, as Mr. Phelps is not here.

The paper will be found on page 60.

We will next have the paper entitled "Stream Pollution from Surface Drainage as the Limiting Factor in Sewage Purification," by George H. Norton, of Buffalo, N. Y.

MR. NORTON: Mr. Chairman and Gentlemen, I think, being called on a second time this morning, I owe an apology to you all. The view that I have outlined will be offered in the nature of a suggestion only, and not advanced as any definite proposition. I have prepared this paper as one for the committee. It is very short, and I am afraid will not be generally interesting, excepting to those from cities which are confronted with problems similar to those along the Great Lakes.

The paper will be found on page 69.

PRESIDENT HOWELL: The secretary has some important matters to present to the association.

SECRETARY BROWN: The amendment to the constitution which was presented on the first day ought to be voted upon to-day and I will read the amendment as it was made by the chairman of the committee which proposed it.

Resolved: That the list of standing committees of this Society as contained in the Constitution, Art. IV, Sec. 4, be amended as follows: Add committees to be called "Committee on Street and Sidewalk Design," and "Committee on City Planning." Change title of "Committee on Park Development and Maintenance" to "Committee on Parks and Parkways"; also change title of "Committee on Traffic on Streets" to "Committee on Traffic and Transportation."

On motion, duly seconded, the amendment was unanimously adopted.

Adjournment was then taken to 2 o'clock.

AFTERNOON SESSION.

The meeting was called to order by President Howell.

PRESIDENT HOWELL: We will now listen to the report of the Committee on Standard Specifications, and in the absence of Mr. Tillson, Chairman, Mr. Sherrerd will act as chairman.

MR. SHERRERD: Mr. President and Gentlemen of the Convention: I will say, at Mr. Tillson's request, I have been acting as chairman of the committee, Mr. Tillson being unavoidably detained from attendance at this convention on account of an investigation growing out of the collapse of the subway construction work in New York City. We will present first for your consideration certain of the specifications about which there seems to have been very little controversy, and suggest that action be taken on each recommendation for specifications as it is reached in the Committee's report; in other words, that as we take up the different specifications and act upon the same after hearing the report of the respective sub-committees.

REPORT OF COMMITTEE ON STANDARD SPECIFICATIONS.

MORRIS R. SHERRERD, Chairman pro tem.

Your Committee on Standard Specifications has held since Monday morning, almost continuous hearings on the reports of the several sub-committees on standard specifications. All of these hearings have been open and a free discussion of all matters before the committee has been allowed.

For the most part the specifications presented are corrections of errors or the removal of ambiguities and slight modifications of the specifications adopted last year, and the general committee would recommend the adoption by the society of the reported specifications to be presented by the sub-committees on sewers, stone block pavements, brick pavements, asphalt pavements, broken stone and bituminous mixtures for roads, respectively, and would call on the representative of each of said committees to present its specifications and to explain the proposed modifications from the printed specifications in the following order:

First—Sewers.

Second—Stone block pavements.

Third—Brick pavements.

Fourth—Asphalt pavements.

Fifth—Broken stone pavements and bituminous mixtures for roads.

Regarding the proposed specifications for concrete paving, only one member of the committee being present and the hearings before the general committee disclosing the advisability of considerable modifications in these specifications, this member of the committee was requested to suggest a form of specifications which after discussion and with foot notes added by the general committee is recommended for adoption.

On bituminous concrete paving specifications, your general committee feels that it is under instructions from the Boston convention to lay before this meeting two forms of bituminous concrete specifications. One is "Grading X" and the other marked "Grading Y," as presented in last year's proceedings, one being a specification which has been claimed to be practically Bitulithic pavement, and the other a modified form of Topeka asphalt mixture. They suggest, also, that the question of the adoption of a patented form of pavement as a standard be submitted for the consideration of the society, provided the owners of such patent agree that the other form of bituminous concrete is not an infringement of their patents. This the general committee understands has been done, and we would, therefore, ask the sub-committee to present its report along these lines, and the general committee feeling that the question is so largely one of policy while believing that definite action should be taken to avoid the confusion now existing in regard to these forms of pavements, would recommend that a vote be taken on the question of adopting the Bitulithic pavement as a standard form of bituminous concrete pavement.

Referring to the proposed specifications for wood block pavements, your committee has met several times with the single member of the sub-committee present and with others interested, purposely postponing its sessions in order to give every opportunity for full discussion.

It recognizes that the specifications presented are a radical departure from those suggested at last year's convention, and contain some excellent requirements, especially in the manner of the treatment and laying of blocks, and altho positive assurances were given that under its provisions blocks treated with either a straight distillate oil or an oil with an addition of coal gas tar would be readily obtained, and while it may represent a fair compromise between the extreme views expressed at our hearings, we are not ready at this time to recommend its adoption to the convention, but would recommend that these specifications be printed in the proceedings.

In order that the widest publicity be secured and that full discussion may be had, we further recommend that the incoming sub-committee on wood block paving specifications be directed to report to the secretary of the Society not later than February 1st, 1916, additional forms of oil specification which he shall cause to be printed with the proceedings of this meeting (it being understood that the proceedings are not to be delayed to include such suggestions).

Your general committee would suggest that the president direct the several sub-committees to more fully consider their reports prior to the date of a convention, and that the chairman of such committees transmit a copy of their advanced reports for publication with the advanced copies of papers, also that the sub-committees meet on the day preceding the first day and report to the general committee on the first or second day of the sessions of the convention, and further that when a majority of a sub-committee is not in attendance at the convention, the president be authorized to appoint additional members of such committee from the membership of the Society present at the convention.

Respectfully submitted,

Morris R. Sherrerd,
Chairman pro tem.
E. A. Fisher,
John B. Hittell.

The first sub-committee report will be that on sewers.

MR. HERING: Mr. Chairman, in the absence of Mr. E. J. Fort, chairman of this sub-committee, I hand you the report. Is there anything else that you desire?

MR. SHERRERD: It was thought that each chairman of a committee would be more familiar with the particular subject and would make a brief statement of what is the proposed change that you recommend, and if you could briefly go thru your report, so that the convention will gather just what is intended to be covered by it, the convention will then be in a position to act advisedly on it.

MR. HERING: In the absence of Mr. Fort, I beg to state that we had a copy of the specifications, passed last year, and also copy of proposed substitutes for certain articles for our consideration. We considered them after we got a few communications from the members regarding those amendments. We adopted some and rejected others. You will find printed in the booklet, issued by the Society, the printed amendments at the end, pages 70 and 71.

I suppose I might as well read our report, which practically covers the entire subject. I was under the impression that this report was to be presented at the end of to-day's session, just as printed in the program, and therefore I did not prepare myself to speak at this moment. This is the report of the sub-committee to the general committee, of which Mr. Sherrerd is the chairman pro tem.

REPORT OF SUB-COMMITTEE ON SPECIFICATIONS FOR SEWERS.

The sub-committee on Specifications for Sewers has further considered Articles 206 and 211 of its report, and the proposed amendments thereto, all of which were omitted from the Specifications for Sewer Construction, as adopted by the society at its last convention.

Article 206.—The amendment proposed by Mr. Parmley would materially reduce the specified thickness of reinforced concrete sewer pipes of large sizes. After careful consideration we are unable to recommend at this time the adoption of the dimensions proposed in the amendment. We also find the subject matter of the proposed amendment, covering the depth and details of socket and joint ends and of reinforcement material, is sufficiently covered by items of the specifications heretofore adopted.

We do, however, recommend that column 4 of Article 206, as proposed by the sub-committee, be omitted.

Article 211.—The amendment offered by Mr. Parmley proposes three different methods of applying crushing tests to reinforced cement concrete pipes, and specifies a different crushing load for each method. The sub-committee has considered these, and reached the opinion that proposed methods 1 and 2 are too complex, and hardly practicable, and that method 3, which substantially complies with the method proposed by the committee, specifies crushing loads which, in our opinion, are too low and unsafe.

The sub-committee has further considered Article 211 and has reached the additional conclusion, that the test pressures which the pipes shall withstand should be specified with more definiteness than at present. With this end in view it recommends the insertion of the words: "without collapse" before the words, "the following pressures," at the ends of both the first and second paragraphs of Article 211.

Otherwise, the committee recommends the adoption of Articles 206 and 211 as originally presented by it, with the omission of column 4 of tabular socket dimensions in Article 206.

Respectfully yours,

E. J. Fort, Chairman.
Rudolph Hering,
A. J. Provost.

MR. SHERRERD: Mr. President, I would move the adoption of the committee's suggestions and modifications on sewer specifications.

The motion was duly seconded and carried.

MR. HERING: May I add a few remarks? Yesterday a paper was read here offering some criticism on these specifications. Of course, they have not been before the committee, and what I say is simply personal. Some criticism was made that the porosity was definitely stated for vitrified clay pipe and cement pipe. Speaking generally, we cannot have the same porosity for vitrified as for cement pipe. This criticism stated that the porosity in the cement pipe was too great and would let typhoid germs pass thru the pores of this pipe. The Pasteur-Chamberlin filters which keep germs from passing thru have a greater porosity than the greatest you would be likely to get with concrete pipe, and yet that is one of our best germ-proof filters. Therefore I do not think that criticism can hold.

Another is the question about smoothness. If you will have that as a requirement of all pipe, you must not forget the effect of projections at the joints. Therefore, we have specifications that the internal vertical diameters should not differ much from the normal. The joints of clay pipe are bound to have a projection, due to warping in burning. We prescribe there shall be no projection at the bottom, and that all the projection shall be at the top where it will do the least harm. Cement pipe can be laid without any of those projecting joints, because it is smooth and retains its circular shape. Now, the difference in the friction and therefore the capacity of the pipe, caused by the projections at the joint, is greater than the increased friction in a cement pipe, from it not being as smooth as vitrified pipe.

MR. SHERRERD: The next committee report we would ask to be brought up for your consideration is that on Stone Block, but Mr. Ramsey does not seem to be present, so the third report is that on Brick Pavement.

REPORT OF SUB-COMMITTEE ON SPECIFICATIONS FOR BRICK PAVING.

Your sub-committee on brick specifications respectfully submits the following report:

We have received no suggestions or criticisms during the past year of the brick specifications as adopted by this society in 1914 from any active member of this society.

We have, however, received from the Brick Committee of the National Paving Brick Mfrs. Association several suggestions for modification. These have been given due consideration.

We would recommend that the following changes be made:

Page 3, Section 1, first line; omit the words "strictly No. 1 Pavers." Inasmuch as cities use different abrasion tests, this term is confusing, because what would be a No. 1 paver for one city, might be considered a No. 2 for another city.

Last paragraph of Section 2, page 4, and third line; add the words "and inspection" after the words "test" also "tests."

Page 17, second paragraph, third line; change the words "one-half days" to "two hours."

Page 20, add to note to engineers, "where a cement grout filler is used, a repress or wire-cut-lug block or brick may be used.

During the past year quite a number of brick pavements have been laid on a mortar bed cushion. Your committee is investigating this method of construction. We are not prepared to make any recommendations at this time, and will appreciate it if the members of this society will communicate with this committee in regard to their experience with this class of construction.

E. H. Christ, Chairman.
F. J. Cellarius,
S. Cameron Corson,
Henry Maetzel.

MR. CHRIST: I move the adoption of the report.

The motion was seconded by Mr. Sherrerd and carried.

MR. KINGSLEY: Before you get thru with the Brick Committee chairman, provided he is the chairman next year of that committee, I would like to make a request that the secretary of the Society transmit to the new Brick Committee a request to make a thoro investigation from an impartial standpoint of the so-called vertical fiber brick, which are being used so extensively in the West and Southwest. We are using a great many of them. Personally, I doubt very much whether they are going to be a huge success, but I would like to have the brick committee go into it and report to the Society at the meeting in Newark.

PRESIDENT HOWELL: Do you make that as a motion?

MR. KINGSLEY: Yes, I will make that as a motion.

The motion was seconded and carried.

MR. SHERRERD: The next committee report I would like to ask you to consider is that on Asphalt Pavement, Mr. Smith, Chairman.

REPORT OF SUB-COMMITTEE ON SPECIFICATIONS FOR ASPHALT PAVING.

After careful consideration of last year's sheet asphalt specifications, it is our opinion that at present only minor changes should be made in them. The changes which we would recommend are as follows:

Page 5, sixteenth line from bottom. Change "smallest" to "largest."

Page 10, last paragraph of clause 12. Change this so as to read, "no binder shall be laid when in the opinion of the engineer the weather conditions are unsuitable or unless the concrete on which it is to be laid is, *even tho damp,* free from pools of water, and has set a sufficient length of time.

Page 10, clause 13. Change the maximum permissible limit for material passing a ten-mesh screen, from "thirty per cent" (30%) to "thirty-five per cent," (35%).

Page 10, clause 14. Change the maximum permissible temperature for the sand from "three hundred seventy-five degrees F." (375°) to "four hundred degrees F." (400° F.).

Page 13, clause 17, paragraph a. Change so as to read, "Have a contour substantially conforming to that of the pavement as first laid, and free from depressions of any kind, exceeding *one-half* (½) of an inch, in depth, as measured between any two points *three* (3) *feet* apart on a line conforming substantially to the original contour of the street."

Page 22, clause 29, "Method of sampling." Insert the following after the word "examined" on the third line of this paragraph. "These samples are for the use of the testing laboratory only and should not be used for testing at the plant before submitting them to the laboratory."

Page 22, clause 30. Add to the last sentence on the bottom of the page, the following: *"and at a point not less than four (4) inches distant from the top and sides of the barrel."*

Page 23. Change the first paragraph on this page so as to read as follows: "The contents of the tank should be heated until completely liquid thruout. It should then be agitated and thoroly mixed

by means of air or steam, *after which the sample shall be taken from the dome in such a manner as to obtain the asphalt from a point at least three (3) feet below the surface."*

Francis P. Smith, Chairman,
Lester Kirschbraun,
Felix Kleeberg,
R. Keith Compton,
Matthew Brown.

MR. SMITH: I move the adoption of the report.

The motion was seconded by Mr. Sherrerd and carried.

MR. SHERRERD: We will now return to the report of the Committee on Stone Block Pavement, Mr. Ramsey.

The report with the revised Specifications will be found on page 446.

Mr. Ramsey moved the adoption of the report, which was seconded by Mr. Sherrerd and carried.

MR. SHERRERD: The next committee report which we would ask you to consider is that of the Committee on Broken Stone and Bituminous Mixture for roads, by Prof. Blanchard.

The report, specifications, and discussion will be found on page 424.

Mr. Blanchard moved the adoption of the specifications, and it was carried.

MR. SHERRERD: Mr. President, that disposes of the specifications which the committee felt could be adopted by the convention without very serious dispute. We have had some difficulty in consideration of some of the sub-committee's work from the fact that less than a majority of the sub-committees were represented at the convention. Regarding the proposed specifications for concrete paving, only one member of the committee was present, and the hearings before the general committee disclosed the advisability of considerable modifications in this specification; so this member of the committee, who was Maj. Crosby, was requested to present suggested forms of specifications. This will be presented by a member of the committee, Mr. Cummin.

The report of the sub-committee on Concrete Paving with specifications and discussion will be found on page 389.

MR. SHERRERD: Gentlemen, you have heard this suggested substitute for the specification on Concrete Pavement, and the general committee felt it was a decided advance step over the form adopted heretofore. I would recommend, therefore, the adoption of this form.

The report was adopted.

MR. SHERRERD: On the question of bituminous paving the general committee would make the following report:

The portion read from the report of the Committee on Standard Specifications will be found on page 514.

We would ask Mr. White, chairman of the sub-committee, to submit his report to the Society.

MAJORITY REPORT OF COMMITTEE ON BITUMINOUS CONCRETE PAVING SPECIFICATIONS.

LINN WHITE, Chairman.

The report of the sub-committee on Bituminous Concrete Paving Specifications, as has been stated by the general committee, was not adopted at the Boston meeting. It was printed in the proceedings for the information of the members and for discussion at the convention at Dayton. To get the matter before the Society clearly, it probably would be proper for me to read the preamble to the proposed specification.

Reads from page 691 of the 1914 Proceedings, commencing with "Your sub-committee on Bituminous Concrete Paving prepared a report for submission to the meeting of the Society in Boston during October, 1914, which consisted of a modification of the previously published specifications of the A. S. P. S., for bituminous concrete," etc.

The revised paragraph referred to reads as follows: "The committee feels that attention should be called to the fact that there has been litigation in certain localities relative to specifications where the mineral aggregate has consisted of coarse aggregate of over

½-inch in size mixed with a finer aggregate, but this committee thought no such question could be raised in connection with Specification Y. This committee furthermore recommends where corporations have not in their employ highway engineers expert in matters pertaining to construction of bituminous concrete pavements, that they avail themselves of the services of experts on this subject." We should like to add that after the publication of this report in the proceedings there was no further effort made by this committee to arrive at an agreed set of specifications with the Warren Brothers Company until we came to this meeting. There are present three of the members of the Bituminous Concrete Committee—myself, Mr. Connell and Mr. Kingsley. The other two members were Col. Ruttan and Mr. Naberhuis. As chairman, I addressed a letter to the absent members asking if they would be at this meeting. I received no response from them. Therefore, the three members of the committee present have discussed this subject with representatives of the Warren Brothers Company, and endeavored earnestly to arrive at some agreement upon a specification we could recommend to this Society as a non-infringing pavement that would represent good practice, or I might say, standard practice in the construction of such pavements. Our efforts have not been productive of much result. In these discussions propositions were made by the different ones with reference to modifications of the grading of the aggregate, but we did not seem to get very far away from what is called the Topeka grading in our former specification. Therefore, this committee offers a report signed by two members, Mr. Connell and myself, which in effect is the report printed in the Boston proceedings. Mr. Kingsley has not signed the report. As these specifications have been printed, and as the gradings stand under the headings of X and Y, I do not know, unless it is requested, that there is any use of my reading it over. I therefore move the adoption of the report of this committee as printed in the Boston proceedings, providing for gradings X and Y as stated.

MR. CONNELL: I second the motion.

MR. SHERRERD: Mr. President, do I understand correctly that the motion before the meeting is the adoption of the report as presented by the chairman of the sub-committee?

PRESIDENT HOWELL: That is my understanding of it.

MR. SHERRERD: If that is the case, the general committee would beg leave to make a statement, namely that the report the sub-committee now makes is not the report that the sub-committee informed us last evening it intended to present. We understood, and the sub-committee at that time suggested that it had come to some agreement as to this question of patents and that the matter was to be submitted to a vote of the convention. Now the sub-committee comes in with a report which entirely ignores the former recommendation of the Society and, under the circumstances, in order to attempt to arrive at some conclusion of the matter, I would move, as a substitute to the adoption of the committee's report as made by Mr. White, that the matter be again referred to the general committee for consideration and brought up at this evening's session.

MR. CONNELL: I just understood not more than one minute ago, from Mr. Sherrerd, that the general committee were going to right here and now withdraw their report that they submitted before Mr. White read his report. If that had been done, the matter would have been perfectly clear and Mr. White's report could have been put before the convention. The members of this committee will not be here to-night. I further recommended right here that this committee, consisting of Mr. White, Mr. Kingsley and myself vote on withdrawing this supposed tentative report, about which there seems to be some misunderstanding, and Mr. Sherrerd said no, he would get up and withdraw his report. I distinctly told him that the committee would not be here to-night. The report before the house is that of the majority of the committee, consisting of Mr. White and myself.

PRESIDENT HOWELL: Then you want the matter taken up now.

MR. CONNELL: We want the matter taken up now, while we are all here. So far as I can see, there is only one report before the convention. The specifications committee it seems were under some misapprehension as to the report that was presented yesterday, which was drawn up on tentative lines when they were trying to come to an agreement with Warren Brothers as to a specification that would be suitable to the committee. They could not come to an agreement with Warren Brothers on that, and so the Committee on Bituminous Paving has presented a report which is identical with last year's specification, which includes two gradings. They have simply added

a paragraph, which was read, referring to the possibility of litigation with one of the specifications, and stating that there would be no possibility, in their opinion, of litigation with reference to the second specification and furthermore, recommending the employment of experts when necessary. Now that seems to be perfectly clear to me, and I think it is perfectly clear to everybody what the intent of the committee is, and I think the main thing to do is to accept or reject the report of the committee, as presented by Mr. White. If Mr. Sherrerd will agree to withdraw his previous report, that will simplify matters. The issue is not clouded so far as this Bituminous Paving Committee is concerned, and they want to present this matter before the convention so that the issue will not be clouded in any respect. With the permission of these gentlemen I am going to suggest that the wisest thing would be for them to withdraw the report that they supposed was the report of the committee and vote on the report that Mr. White presented, which actually is the report of the committee, and that it be taken up now by this convention.

MR. KINGSLEY: To get this matter before the house as I think we should and in line with the report as submitted by the general committee, the minority member, myself, of this committee has submitted a report in line with our agreement and discussions with the representatives of Warren Brothers Company, yesterday, at several sessions, and again to-day. Now, Mr. President, as a substitute for the whole matter, I move that this minority report, which is in the hands of the chairman of the general committee, be adopted as the report of this committee.

Motion seconded.

MR. CONNELL: Mr. Chairman, that is out of order. There is already before the Convention the report presented by Mr. White. The main thing to do in this connection, it seems to me, is to vote first on the report of the majority of the committee. Then the minority report can be presented. The minority report is out of place before the majority report is acted upon. The committee must be recognized.

SECRETARY BROWN: Mr. Chairman, I believe a point of order has been raised before in connection with these reports of the subcommittees and the general committee. The Society has uniformly

refused to consider any report of a sub-committee which has not presented its report to the general committee, and the general committee then makes its recommendations to the Society. I think, therefore, that we are out of order in allowing the sub-committee to present its report without the recommendation of the general committee.

MR. KINGSLEY: I would like to say on that matter that the minority report was submitted to the general committee yesterday and it was practically agreed with the general committee that it would be the report. The general committee's report is absolutely in line with the minority report which I have submitted. The general committee asks this committee to submit the report to the convention assembled, and that is why Mr. White submitted the report rather than Mr. Sherrerd.

MR. HITTELL: As a member of the general committee, I do not want the impression to go forth that we so understood it. I think Mr. Fisher will agree with me and Mr. Sherrerd, that we understood that the report as submitted by Mr. White and Mr. Kingsley was simply to the effect, in unscientific language, that they were giving us a specification that would be an improvement on the Topeka mix, which the Warren people agreed was not an infringement of their patent. They submitted to us the question of whether the Society should print in its proceedings a specification for a patent pavement, and surely our report covers our thoro understanding of the matter the way it was presented to us.

MR. LINN WHITE: I am very sorry this confusion has arisen. The storm center seems to be around the majority members of the committee, and perhaps we have acted without a clear guidance in the matter. I wish to state my understanding of the situation. Yesterday there were two members of the committee present, myself and Mr. Kingsley. Mr. Connell did not arrive until this morning. Yesterday when we were before the general committee we presented what we intended to be at that time purely a tentative report, which was not complete and in fact did not have in it any grading whatever. We assumed at that time that we were going to get together. We had had several conferences with Mr. Warren and had been hanging upon the question of grading. Mr. Warren had volunteered to obtain from certain sources of information—from

his office, I believe—the actual grading of stone-crusher run. We had not agreed upon any grading, and we did not present any grading to the general committee. On Mr. Warren's suggestion, we waited until he could get a reply to his telegram, which was received this morning early. We were discussing this back and forth, and I think Mr. Warren will bear me out that we did not go to breakfast until nearly noon. Mr. Connell came in during the morning and the three members of the committee had a conference, and came to a difference in opinion. Mr. Connell and I concluded, and now are firmly of the opinion, that the gradings we could agree upon are in nowise an improvement upon the Topeka grading. This is as clear a statement of the situation as I can make. I feel I must apologize to the general committee if I have not acted in line with duty as chairman of the sub-committee. We did not have time to reach the general committee with this report, except merely to say to Mr. Sherrerd after this meeting was called to order, that we had not been able to come to an agreement with the bitulithic company. Therefore we could not present a compromise report. We did not think the grading Mr. Warren would agree to, was any improvement over the Topeka specification. Therefore, we fell back on the Boston report as the report of the committee.

MR. KINGSLEY: I would like to add one word to what Mr. White has said, in behalf of the general committee. It is a fact that we did have this meeting with the general committee, and this report of the general committee was prepared and submitted to us as what they would submit here. Mr. White and I, both told the general committee at its last meeting that we had practically come to an agreement with the Warren Brothers, and were both reasonably sure that we could; we were simply waiting on some telegrams which Mr. Warren expected from Boston for a little additional information regarding his paving materials. That is the reason why this general committee has submitted its report, which is absolutely in line with the minority and not the majority report.

SECRETARY BROWN: I ask for a ruling on the point of order.

PRESIDENT HOWELL: The chair decides that Mr. Brown's point of order is well taken, and that this matter is not before the convention at all. It should be presented to the general committee, and anything should come properly from the general committee.

MR. SHERRERD: Mr. President, that action is exactly in line with the motion that I made, namely that the sub-committee's report be referred back to the general committee and taken up for consideration at this evening's session. And I would suggest that this motion be put to a vote of the Society so as to clear our proceedings.

MR. CONNELL: A few moments ago the chairman of the general committee asked for a recess of five minutes to consider this matter. It seems to me the object of this committee is to get before this convention the report of the sub-committee while the members of the committee are here. That seems to be very clar. It seems to me that it would be in order to have this report presented now to the general committee and have a recess of five or ten minutes for the general committee to consider the report and have it come before the convention right here and now. It does nothing more than confuse the issue if this matter is put over until to-night, as I clearly stated that the members of the committee will not be here. I make a motion that the report be referred to the general committee and put over until after the wood block committee has been heard, and that it be considered at the afternoon's session and not put over until this evening.

MR. SHERRERD: I accept that.

MR. WHITE: I will withdraw the report if that will facilitate matters any.

MR. KINGSLEY: I move as a substitute motion, Mr. President, to the motion that has just been made, that the report as made by Mr. White representing the majority committee report of this sub-committee be rejected.

Motion seconded.

SECRETARY BROWN: That motion is out of order for the same reason as the other.

MR. WHITE: I arise to a point of order. I do not think that is a proper motion, as it would be no solution of the difficulty. That is taking snap judgment.

PRESIDENT HOWELL: I think we had better go back to Mr. Connell's mtion that this be laid over until after the Wood Block Committee is heard, and referred back to this general committee to be taken up at this afternoon's session.

MR. FISHER: It is just a question of courtesy. I hardly think the General Specifications Committee should be rushed in what it is going to do.

MR. CONNELL: Mr. Chairman, I do not want to be discourteous to the general committee, but I am just asking the general committee to help out the situation, by getting rid of all of these reports this afternoon. I think that was the original object of this Convention.

Mr. Connell's motion was then put up and carried.

MR. SHERRERD: Mr. President, to continue the report of the general committee referring to the last knotty problem that was presented to us, proposed specifications for wood block, in report:

Reading from the report on page 514, *beginning with "Your committee has met several times".*

In order that it may be fully before the Society, I would ask Mr. Dow to present the suggested specifications.

MR. DOW:—In presenting this proposed specification to the Society I wish to state that as I was the only member of the committee on wood block paving present at the convention the general committee requested me to draw up specifications which I would recommend for their consideration. This I have done. The specifications therefore presented, do not represent the ideas of the committee, altho one other member has expressed his approval of them. I will not read the proposed new specifications but will only take up the portions which have been changed from last year.

In the first paragraph relating to timber there are some modifications made in order to admit woods that are found in the eastern market. The specifications presented last year were very good in this respect but might be considered as more applicable to yellow pine of Mississippi and northern Louisiana. We often have in the eastern market what is known as Cuban pine. This is a very heavy

wood containing a great deal of rosin, and is often found very coarse grained. So as to admit this wood I have made the following change:

(*Reads "In yellow pine timber," etc.*).

In the paragraph on the size of the block some little change has been made. In last year's proposed specifications different sizes of wood were specified. We have now left blank places for the sizes with a foot note commenting on where the different sizes are applicable. This paragraph now reads as follows: "The blocks shall be from 5 to 10 inches long," etc.

In the paragraph on preservative there is a radical departure in that suggested for this year from that of last year. Last year's specifications admitted either a very heavy coal tar distillate oil or a mixture of medium gravity distillate oil with refined coal tar. The amount of refined coal tar admitted under last year's specifications might amount to 60% of the oil. Before preparing this year's specifications I made a study of the situation thruout the country and found that the creosoters in the South and Southwest, along with the Yellow Pine Manufacturers' Association, were strongly opposed to the use of coal tar mixed with distillate oils and that they desired to use only medium grade and heavy distillate oils for the treating of their blocks. As you all know, the creosoters of the North and East have been using mixtures of refined coal tar and creosote oil in their blocks for a number of years with marked success. This diversity of opinion has resulted in more or less confusion in specifications with the result that it was often the case that a wood block manufacturer was obliged to keep three or four different grades of oil on hand to meet the requirements of different cities. It can be seen from this the great importance of reconciling the different interests so as to have one specification for preservative oil for wood block. It is with this idea in view that I am presenting to you the specifications contained herein for the preservative. These admit coal tar distillate oil of from medium to heavy gravity or will admit an admixture of not more than 30% of refined coal tar with a medium gravity creosote oil. Practically all the imported English and German distillate oils would come in under these specifications. Oils of this type are preferred by the southern creosoters. The northern and eastern creosoters can also make an oil complying with these specifications out of the same in-

gredients which they have been using except that they will be obliged to reduce the quantity of refined coal tar oils and increase the quantity of medium distillate oil.

Under paragraph 3 I have made a slight change in the percentage of distillate up to 315° C. from that presented to the general committee. This was changing 45% to 35%. The change was made to make the specifications still broader than at first suggested and yet require a good oil.

In last year's specifications we required the distillate between 235° and 315° C. to have a gravity of 1.02 at 60° C. compared with water at this temperature. In these specifications we require it to be less than 1.02 at 38° C. compared with water at 15.5° C. By calculation you will find that this is practically the same requirement.

In the last part of the fourth paragraph the requirement for the specific gravity of the distillate between 315° and 355° C. is new, not being contained in last year's specifications.

Fifth paragraph: "The specific viscosity at 82° C.," etc. This is also a new test not contained in last year's specifications.

Sixth paragraph: (*Reads.*) The wording of this paragraph was slightly changed from last year, altho the meaning is the same.

Paragraph on Treatment: (*Reads.*) This paragraph is practically the same as the one in last year's specifications. I have gone a little more into detail, however, with the hope of getting better results. In last year's specifications we did not give any time for steaming and no time for the vacuum. The minimum temperature of the oil when admitted to the cylinder has been raised from 170° to 180° C. The question about untreated sapwood is new in this year's specifications and was suggested by Dr. Von Schrenk after his investigation of rotting blocks which he has been carrying on for the past year. He finds that many cases of rotting take place in untreated sapwood. There is no excuse whatever for untreated sapwood if the blocks are properly handled, as this is the part of the wood most easily treated. It is for this reason that I am insisting on a thoro treatment of the sapwood.

In the next paragraph on handling the blocks after treatment (*Reads.*) "After the blocks have been treated and before they are

laid," etc. This is a new clause not contained in last year's specifications which has been inserted because I believe that a great deal of the trouble with wood block pavements comes from the fact that they are improperly handled after the blocks have been treated and before they are laid on the street. If water is allowed to dry out of the blocks before they are laid they are bound to re-absorb that water again and if they have been laid this absorption will result in the expansion and possibly buckling of the pavement. For this reason I think that the blocks should be kept as moist as possible just before laying.

A slight modification has been made in the paragraph on inspection so as to have it understood that a final inspection for the quantity and kind of preservative is to be made at the plant and that the street inspection is only intended for the throwing out of imperfect blocks.

The paragraph on cushion A, mortar bed, is practically the same as that of last year with slight modifications.

The paragraph on cushion B, sand, has been changed so as to require a loamy sand, the object being to secure a bed that will not shift so readily as will a clean sand. Last year's specifications called for clean sand, which I believe is wrong as such a material often shifts under the wood block, causing unevenness in the wearing surface. By calling for a certain percentage of loam in the sand this shifting is overcome to a considerable extent.

The paragraph for laying blocks is substantially the same as last year except that it is not necessary to lay a row of blocks parallel with the curb to form the expansion joints. There is also a slight difference in this paragraph, in that I specify that the blocks shall be rolled with a roller weighing between 4 and 7 tons. In these specifications I also require that the blocks shall be laid closely instead of, as worded last year, loosely, but in both the specifications the maximum width of joint between the blocks is ⅛", so that they are practically the same in this respect.

In these specifications there are two paragraphs on Filler, one for Filler A, sand, and the other for Filler B, Bituminous. In each of these paragraphs the methods of using the two fillers are more definitely specified than they were in last year's specifications and in the last paragraph on Bituminous Filler, the tests for the filler are given and also it is required that the kettles in which the filler is

heated on the street shall be provided with thermometers so as to have the filler at the proper temperature when poured.

At the end of these specifications is the same note which was in last year's specifications, which reads as follows:

"Engineers should not use this specification as a whole, but should make a selection of the materials and methods where more than one is indicated under the different headings." We are also to print methods of analysis of the creosote oil, and so as to keep those in uniformity with the American Society of Testing Materials, we will copy the matter as given tentatively is last year's report of that Society of Committee D-7. It is under the heading of proposed Method for the Handling and Analysis of Creosote Oil.

MR. SHERRERD: Mr. President, the specifications having been read, as considered by the committee, we would move that the recommendations of the general committee be adopted, namely that the incoming sub-committee on Wood Block specifications be directed to report to the secretary of this Society, not later than Feb. 1, 1916, additional forms of oil specifications which the secretary shall cause to be printed with the proceedings of this meeting.

MR. CHRIST: I would also like to add that the proceedings be completed and published at that time.

MR. SHERRERD: I accept the amendment.

The motion was put and carried.

The report of this committee was not received in time to be included in this volume. The specifications presented by Mr. Dow will be found on page 456, *together with proposed changes in and additions to the specifications for oils with which to treat the blocks.*

MR. DURHAM (*by letter*): In view of some of the statements that have been made in reference to the position of New York City on wood block pavements, the writer feels it proper to express some views based on several years' supervision of this class of work.

In the Boro of Manhattan, there are to-day 34 miles of wood block pavements out of a total of 456; 13 miles of which have been laid under the writer's direction and are to-day in excellent condition and giving entire satisfaction in every respect.

The question of the problem of "bleeding" has given a little trouble on some of these during their first season in extremely hot weather, but had there been carried out during the past year the provision which the writer introduced into these contracts for the periodical sanding of these pavements when necessary, this trouble would have been obviated.

The specifications for treatment of wood blocks adopted in 1913-1914 for the Boro of Manhattan are in line with the recommendation of one of the speakers, that the most important feature is to provide for careful treatment. Provision was allowed for some variation in the quality of oil in order to obviate any question of monopoly. It is the writer's belief that the only point necessitating improvement was to reduce the amount of oil per cubic foot to a maximum not to exceed 16 lbs. The general fault in our wood pavement has been to use an excessive amount of oil, which merely served to render the surface unpleasantly sticky for a year or two.

Whatever may be the individual opinions of different administrations in regard to this class of pavement, it is a fact that a large extent of it is in good condition and giving satisfaction in New York City to-day. It is also true that it has the approval of the majority of the Boro Engineers and that the principal reason for not laying much of it during the coming year is not because of any prejudice against this form of pavement, but a shortage of funds, which has rendered it desirable to use what little appropriations were made over as great an area as possible.

Any one who will examine the stretch of wood pavement over three miles in length on Eighth Avenue from Abingdon Square to Columbus Circle; that on Broadway extending from the latter point for a mile to the North; various sections on Amsterdam Avenue in this vicinity, and the sections laid with wood in the test area on Second Avenue between Houston and 23rd Street, will have ample evidence that wood block pavements can be laid satisfactorily in this country. It is doubtless true that the majority of teamsters would vote for granite block exclusively, but our streets must be paved with references to the wishes of all users, and an unfair impression would be conveyed were it thought that there is any prevailing sentiment in New York City against further use of wood block for a pavement surface.

Mr. Sherrerd: The committee submits some general recommendations in its report. Your general committee would suggest that the President direct the sub-committees to consider more fully their reports prior to the date of the convention and that the chairman of each committee transmit a copy of his advance report for publication with the advance copies of papers; also that the sub-committees meet on the day preceding the first day of the convention, and report to the general committee on the first or second day of the convention. And that when a majority of the sub-committee is not in attendance at the convention, the president be authorized to appoint additional members of such sub-committee from the membership present. Respectfully submitted and unanimously agreed to by Mr. Fisher, Mr. Hittle, and Mr. Sherrerd. Mr. President, I move the adoption of these suggestions as read.

The motion was seconded and carried.

Mr. Christ: Now, Mr. Chairman, I make a motion that all communications or requests for amendments or modifications of the specifications of this Society be taken up with the sub-committees on the different specifications previous to the convention, and that if there are no such requests received by the sub-committees previous to the convention, that the general committee do not consider any suggestions from those sources.

The motion was seconded by Mr. Dow.

Mr. Sherrerd: It strikes me that the wording of the motion is entirely too drastic. It would mean that no one attending the convention who might have very valuable suggestions and who might offer them to the sub-committee or the general committee could have such suggestions considered. I would ask Mr. Christ to modify his motion so that it would read that suggestions for amendments or changes in specifications be submitted in writing to the sub-committee at least ten days before the convention, rather than to say that no such suggestions be considered.

Mr. Christ: I believe you misunderstand me, Mr. Sherrerd. I say, that if they bring in any suggestions before the committee, they be considered. But if they do, and the sub-committees do not consider them favorably, that then they can take the matter up with

the general committee. If it is not considered favorably by them, or they do not care to take it up, they ought not to be considered on the floor of the convention. You will find that a great many of the paving material men will not take up anything until they come to the convention. It doesn't give the sub-committee a chance to investigate.

MR. STERN: Can any motion like that prevail? That would be a motion to change the rules of parliamentary practice. We cannot do that. No one can prevent a person at a convention such as this from speaking on any question.

MR. SHERRERD: Mr. Chairman, there is a decided disadvantage in my judgment from another point of view. The sub-committees may not have been able to attend the sessions of this convention—and I assure you that the general committee members have not been able to attend anything in the way of the sessions of this convention—and if it is the purpose of this motion to slide over onto the general committee the necessity of thrashing out every question that may be raised by any member of the association at the convention instead of having it presented first to the sub-committee, then I respectfully submit that such a motion should not prevail.

MR. CHRIST: That is not the intention at all.

MR. SHERRERD: That is what it would do.

MR. FISHER: I think it is all right enough that the members should be requested to bring in all those things, and they ought to get them in, but I do not think we ought to have a drastic clause that we would not consider anything. It might be something more valuable than anything brought up before that. I think it ought to be left to the discretion of the general committee, and the sub-committees.

MR. HOWARD: I would support Mr. Fisher, especially as we often get valuable information at the last moment. I think it wise to leave well enough alone.

MR. SHERRERD: I would move as a substitute to Mr. Christ's motion that the secretary be directed to print in the proceedings a

request that members submit to the chairmen of the several sub-committees any matters which they wish to bring to the attention of the committee, at least ten days before the time of holding the convention.

MR. CHRIST: I will accept that as an amendment.

The motion was then put as amended and carried.

MR. SHERRERD: There is one matter I think we should consider. I feel that we owe a debt of gratitude to Dr. Thompson for his admirable address delivered at the banquet the other night, and that if we could get a synopsis of his talk and print it in our preceedings, it would be of value to the Society. I would therefore move that the secretary be directed to ask Prof. Thompson to give us a synopsis of his address for that purpose.

Motion seconded and carried.

A short recess was then taken by the convention to permit the general committee to meet and consider its report.

MR. SHERRERD: The general Committee on Specifications recommends that the report of Mr. White, which suggested the adoption of the X and Y specifications as printed in the specifications last year be placed before the convention for its approval or disapproval, without recommendation from the general committee.

MR. WHITE: Mr. Chairman, I move the adoption of the report as read by myself, as the report of the majority of the committee.

MR. CONNELL: I second the motion.

MR. KINGSLEY: As the third member of the committee, disagreeing with this committee report, I would like to offer as a substitute a report, as a minority report, which to my mind is in line with the recommendations of the committee at the Boston convention of last year. This report embodies the specifications of bitulithic pavement as a form of standard pavement, not the only form, but a form of standard bituminous concrete pavement. It also adopts a specification which the Warren Brothers Company agree is not in anywise

an infringement, and which to my mind is superior in many ways to the so-called Topeka specifications. I move the adoption of the minority report as a substitute.

Motion seconded.

PROF. BLANCHARD: I rise, Mr. President, to a point of order, and request that the report be read.

MR. KINGSLEY: Mr. President, I had no idea in the world that this report would not be read. I turned it over to the secretary, thinking that we could prevail upon him to read it, rather than to have to read it myself. I certainly think that Mr. Blanchard's point of order is exceedingly well taken. I should hate to think, myself, that the members of this Society, even as much as I hope they think of me, would adopt a report as exhaustive as this and as important as we all think it is, without reading it.

MR. HATTON: It has been the uniform rule of this Society, since I have been a member at least, that we take the reports of general committees on these special subjects as representing the work of the Society, because that general committee has gone into the matter very fully, and knows very much more about the matter than the members individually could know. But here is a case where the general committee is making no recommendation whatever. Why? Because of the sub-committee. Here is a sub-committee which makes a report, and the general committee does not make any recommendations. How in the name of common sense is this Society going to take any action on this report? I think it is ridiculous to ask any reasonable gentleman to vote on this sort of a thing.

MR. CONNELL: The gentleman is evidently under a misapprehension, because the general committee has recommended that the report of the sub-committee be put before the house; that is, the majority of the sub-committee.

MR. FOLWELL: Mr. President, I arise to speak in behalf, not of experts, but of the members of the Society who are not experts. About two or three or more years ago a number of the members of this Society representing smaller cities found themselves getting into doubts, (if not difficulties and conflicting more or less with the law)

as to what they could do in the way of laying bituminous pavements without submitting their town to the danger of the cost of a lawsuit. Some of them did get black eyes before the community, because they did build a certain bituminous concrete pavement, and their towns were compelled afterwards to pay royalties, either with or without lawsuit. After that had gone on for a time, so many requests and appeals were made by members to the Society to tell them where they were at, that finally a sub-committee was appointed with the request that they tell this Society where we *were* at—that they draw up a paper which could be submitted to the members generally of this Society, which would tell them in black and white, definitely, to the line, "you can do this, and we will guarantee as nearly as we can guarantee anything that if you do this and nothing more you will not have a lawsuit on your hands." We could not say, "you cannot do more than this"; but "If you want to do more than this, you must do it at your own risk."

This is what I have understood the members wanted us to tell them. They wanted us to tell them just what they can do, leaving them the option of going further than that if they wanted to, or if their legal adviser told them to that effect. That is what I understand this committee was originally for. And the members want to know *now*—they are building pavements next year, and they want to know now how far they can go in safety without being subjected to a lawsuit. Now, if this committee thinks the minority does not go far enough, that by consulting legal authorities or otherwise they can get more concessions next year, well and good. But I think the members want to know this year how far they can go; and if this committee says, "We cannot get Warren Brothers to guarantee anything better than the Topeka specification, and we cannot get anything better until we have given it further consideration," let them say that. The members of this Society want to know how far they can go, and would like to have the committee get all the concessions from Warren Brothers they can—possibly report progress. But, as I have said, the cities, the highway superintendents of counties, want to lay bituminous macadam next spring, perhaps lay some this fall, and they want to know what they can do with safety, and without being subjected to a lawsuit. Now, it seems to me that the minority committee report, if the report gives what the minority member says in his synopsis that it gives, gives us just that thing.

Mr. Hatton: I would suggest that the specifications in both cases relating only to the top or surface mixture be read.

Mr. Connell: In addition to that the minority report also submits the specifications for a regular bitulithic, which I think should be made clear, and I am going to ask the Secretary to read that also.

Secretary Brown reads paragraph in question.

Mr. Kingsley: There is one clause there regarding the bitulithic cement which we have added at Mr. White's suggestion to the bitulithic specification.

Secretary Brown reads clause referred to.

Mr. Hatton: Mr. President, from what Mr. Folwell has said, it seems to be the desire to push this thing thru so that the members of this association this coming year may have an opportunity to use it. Now, then, isn't it a question whether the minority specification infringes upon the Warren Brothers' patent? Isn't that what the association wants to know; isn't that the gist of it?

Mr. Connell: Mr. Chairman, I have listened with considerable interest, particularly to what Mr. Folwell had to say. He admitted that he was not competent to pass upon this matter. He simply laid stress on the fact that this Society should let the people know what pavement they can lay which will not be an infringement on the Warren patents. In Mr. White's report we have done identically what Mr. Folwell states he thinks this Society should do. We have presented two gradings, one we state there has been certain litigation in connection with and that there might be a question of infringement where the coarser particles are over one-half inch. We further state that under the Y grading there is no question of infringement. That is just for Mr. Folwell's information.

There are placed before this convention by the minority report two specifications, one of which admits bitulithic as one of the standard specifications of this Society, and the other submits a grading that is stated not to be an infringement.

I may say that in some localities they are laying every day without any litigation, the one concerning which we say there has been

certain litigation in connection with it, and in other localities they have been restrained from doing so by the lower courts. Our other specification is practically identical with the one presented in the minority report, and we state that that can be laid without infringement of the Warren patent, so that clears the matter up in so far as all these townships and counties are concerned where they have not thoroly understood this matter.

PROF. BLANCHARD: Following out Mr. Connell's remarks relative to the statement by Mr. Folwell, I think this point should be brought to the attention of the members of the Society. It is questionable what value an agreement between the Warren Brothers and this Society would have in court. I think it would be exhibited merely as a piece of evidence. Furthermore, in answer to the query propounded by Mr. Folwell, it appears that we already have an agreement that the Topeka specifications do not infringe, as stated in the following extract from a court decree: "It appearing to the court that of the mineral matter used in the pavement actually constructed in the cities of Topeka and Emporia, Kansas, no particles of stone were used that would not pass a screen with openings one-half inch in diameter, and that less than ten per cent of the stone or coarse sand used should be retained upon a screen of one-quarter inch in diameter and the remaining mineral matter used being finer that one-quarter inch, and it further appearing that pavements constructed by the use of mineral particles as above described do not infringe the claims of complainant's patent No. 727505 sued upon in this case," etc.; "and it further appearing that the pavements as actually constructed in the cities of Topeka and Emporia, Kansas, do not infringe upon the claims of complainant's patent No. 727505 sued upon in this case, and that any pavements hereafter constructed in substantial compliance with the following formula, to-wit..." It seems to me that the statement just made by the speaker satisfactorily answers Mr. Folwell's first question. The second is relative to the new grading submitted. If you will take the time to analyze the proposed grading, you will find that in the proposed grading there is less stone passing the one-half inch screen and retained on the ten mesh sieve than in the Topeka. There are a few changes in the percentages of the finer material, but such changes have been made all over the United States, and to the best of my knowledge they have never been questioned by the Warren Brothers.

MR. KINGSLEY: I wish to renew the motion that I made a little out of order a few minutes ago, before Prof. Blanchard's talk; that is, that the minority report as read in part by the secretary be adopted by the Society as the report of this committee.

MR. CONNELL: May I say a word first? The question of infringement or non-infringement has never been decided by the Supreme Court of the United States, and it is the duty of the members of this Society, and our duty as representatives of our respective cities, before we recognize the pavement as a patented pavement which will saddle the city with additional expense of a royalty; it is our duty, first as a body to bring the question of infringement and non-infringement of the bitulithic pavement to the highest court of the United States. As it stands to-day, there are certain localities where the patent has been upheld in the lower courts, and there are other localities where it has not been upheld, and where you can lay the pavement to your heart's content.

MR. HOWARD: Patent litigation is very slow and complicated and the litigated Warren patent runs out in a few years, I believe in 1920. The United States is divided into several circuits called United States District Courts. The decision in one circuit does not bind the other. In several Circuit Court cases the Warren patent got favorable decisions and they were appealed to the Circuit Court of Appeals in each district, and have been sustained. The defendant in the Owosso case took its case up to the Supreme Court of the United States which declined to order a retrial or review, on the ground, which the Supreme Court of the United States has always taken, that it will not try a patent case on its merits there, unless there have been contrary decisions in two different U. S. Circuit Courts of Appeals. Therefore, as there are no adverse decisions at present, the Warren patent having been sustained in several lower courts and the several Courts of Appeals connected with them, it is impossible to get this patent before the U. S. Supreme Court. You would have to again go into a Circuit Court and get an adverse decision against the patent. Then, the owner would undoubtedly appeal that to the Circuit Court of Appeals for that district. If the decision is again against the patent then you would have the position of a decision favorable to the patent in one circuit, as the Owosso, Mich., case, and your adverse decision in another circuit.

Then the owners of the patent could appeal to the U. S. Supreme Court to have that court decide between the two contrary decisions of the lower two Circuit Courts. This is the method in this country.

MR. WARREN: I was about to arise and say a word on the question of how patent cases get to the Court of Appeals. Col. Howard well stated it, and I want to add that these patents have about five years more to run, and before that proceeding would get to the Supreme Court of the United States they will have expired. While I am on my feet, Mr. President, I am not an active member of this Society, and I believe that under the rules I have not authority to speak...

MR. SHERRERD: I move that Mr. Warren be granted the privileges of the floor.

The motion was seconded and carried.

MR. WARREN: I don't want to keep you here until breakfast time, as I am due to take a train at 6:35 to-night myself. But I do want to go into this thing sufficiently, so that you will have the issue clearly before you. First, let us take this specification, the present specification X, handed down by the A. S. P. S. It was formulated, as those who formulated it will admit, as a specification which about as clearly infringed the Warren Brothers' basic patent as a specification could be drawn. I want to give you gentlemen a few concrete cases of how that has worked out. One city very promptly said, it does not infringe. They said, we will "go to bat," and they let a contract for 3,000 square yards. It was an important district, a Federal Circuit Court of Appeals covering several states, and we "went to bat." We spent $15,000 to defend the patent on a $6,000 contract. We won. Then the next thing in that same town, a contract was let for a pavement under the same specification, under our license secured by the company which was to furnish the asphalt to contractors who asked no advice from us whatever, and six months afterward one of the stockholders of our company residing in Boston, happened to be in that city visiting friends, and incidentally mentioned that he was a stockholder in Warren Brothers Company and asked if they were doing any business under our patents. The friend said, "If you have got stock in Warren Brothers Company you are on the wrong track. You better go and sell your

stock. I will take you a couple of blocks down here and show you where they are using it." He goes back and he writes me a four-page letter along the line of the iniquity of our allowing a pavement to be laid under the name of our patent by contractors in that manner and asked me to submit to the board of directors his protest against that policy. That same city a little later said, "Why, there is nothing to this. That specification says that the maximum size stone shall be one-half the thickness of the wearing surface. We will just change that a little; just change the maximum size stone to one-half inch, that is all." And we again "went to bat." We went all thru a trial on the merits, and we won, and we spent another $15,000. I don't believe we could ever get a contract in that city now. We have gone thru two patent litigations; we have spent our money, and I guess the city is pretty sore.

Here is another instance. Right here in this state, a county adopts a specification, this specification X, and purposely or unintentionally, I do not know which, makes no reference to the patent. A contractor who is in the brick paving business bid for that contract, and he was the low bidder. He claims now that he did not know the pavement specified is patented. In fact, somebody told him it was not patented; therefore he should have immunity. One gentleman here spoke of a city in Kentucky, and he says he adopted this specification X, which on its face indicated that it provides for a patented construction. A contractor bids for and gets the contract, and claims he did not know it was patented, and with tears in his eyes he asks the city if he may not please be permitted to do something in his mind and not in his contract. I mention those instances, gentlemen, where cities have either been unintentionally or otherwise led into an infringement. The contractors have used the fact that it was not a fair and square specification as to whether it infringed or not, and claimed that they have a moral right to go on because they did not know.

Now, we came down a year ago to the convention in Boston. A certain day and a certain hour were set at which the committee on specifications for bituminous pavement would appear before the general pavement specifications committee with its report as to such amendments as it desired to make to the then bituminous concrete specifications. That was in accordance with the general custom of years' standing of this association, that those committee reports should be in on the morning of the day before the convention meets. Not a single member of that committee was in town on that Mon-

day. Tuesday, two or three of them arrived, with no report. Wednesday they said they had no report. Thursday they again said the report was not ready; but just as the Society was going on a boat ride, they said they would have their report in when the committee came back at six o'clock. The report was to be acted on by the Society at eight o'clock, and in the meantime the dinner hour. That report started out in its introduction in saying that there was no material change from the specification which had been previously adopted. I believe that if I had not happened to know something about the subject, and happened to have been there, there would have been no question raised as to whether or not that preliminary statement was true or untrue. That is the same specification brought before your committee here to-day, and I tell you, as I told you in Boston last year, that is such an indefinite, such an unspecific specification that you could either lay sheet asphalt under it, or you could lay Topeka mixture, or you could lay a bitulithic pavement and comply with the specification. Is that a specification for this Society to adopt? I have made that statement, made it in print to every member of this Society, made it before the committee and now make it here, and it has never been denied. I say that is not a proper specification. Now, you come down to the Topeka specification, which they call "Y". That specification was brought before the courts in the city of Topeka by a man who was as shrewd as anybody in the contracting business. He had executed a contract under a specification, this same specification X, by the way, which clearly infringed. He was enjoined from carrying out the infringement, and when the matter came up for final hearing, he, in connection with the city, produced affidavits signed by all of the city officials, saying that they had decided to change their specifications and lay the work under a different construction. Now, it goes without saying that when they presented that to the court, they presented it with the greaest care and all the best advice they could get from their patent counsel, the best specification which the court would be likely to pass as a non-infringement. It was a non-infringement, as we very promptly stated. There was no controversy over the subject, and the result is that, as Prof. Blanchard has read, the Federal Court in that Topeka case, entered a decree that that particular specification did not infringe, and in the same order enjoined the city of Topeka from carrying out its original contract or making any further attempts to infringe.

At the meeting last year, when there was a wrangle in the committee as to what that new specification brought about, nobody had had a chance to read it, but I got to pretty clearly what it was. I have analyzed it since, and it is just as I say...

MR. SHERRERD: This is X?

MR. WARREN: This is the now reported specification, not the old specification X, but the same one that the committee reported on last year which is the same as they are now reporting again this year. Mr. Connell suggested in the committee, which I happened to attend, that an effort be made to see if the Warren Brothers Company and the Society could not agree on something which would be better than Topeka which did not infringe and which Warren Brothers Company would agree did not infringe. I said to the gentlemen at the time that I would approach the matter with my heart and soul. Their proposition was that Warren Brothers Company formulate something, and that the Committee would take it under consideration. But I also said, "You must bear in mind that when my brother Fred thought of this fundamental principle which is now the bitulithic pavement, he protected it in every way possible." Perhaps we ought to be complimented, when the matter comes up year after year, as perhaps the most prominent thing before this association, but I want to say it is getting very tiresome. So the association at the Boston 1914 Convention following recommendation of the general committee, adopted a resolution under which if Warren Brothers Company would submit a specification which the sub-committee and the general committee would agree as providing a good pavement, or the best that they can agree to as a non-infringing specification, one Warren Brothers Company would say was not an infringement, that then the Society would eliminate specification X, make such a straight out and out specification for a non-infringing construction to be called bituminous concrete, and on the other hand adopt the bitulithic specification. The committee was given three months to settle that. One reason why three months was given was because I announced that on account of absence I would not be able to take it up for two months, and in the meantime I would have our laboratory work on the matter, in conjunction with our patent counsel, and in consideration not only of this one basic patent you are talking about, but about fifteen or twenty others, and that just as soon as possible after my return home, I would formulate

the matter and submit it to the committee. The very day I arrived I received a letter from Mr. White asking me to hurry up that report. I sent that to him, prepared with a great deal of care—and by the way, these two reports were to be printed in the proceedings, so that this convention would have them squarely before it. I submitted that report, which is here, sixteen pages of printed matter. It is a very valuable record, a record which we have never previously put out, and it would cost you a thousand dollars to send to the patent office and engage a patent attorney to tell you what is in that little pamphlet. I sent that report to Mr. White, chairman of the committee, on the 6th of February. It has never been acknowledged to this day, and I am reliably told that some members of his committee were never consulted about that report of Warren Brothers Company. Mr. Brown was also after me to get that report in. When I sent him a copy, at the same time I sent it to Mr. White, Mr. Brown wrote me he was very glad to get it because all the other proceedings were in type, and he would put that part of it in type, and hoped in the course of a week or two to hear from the committee as to their report. He heard from the committee the last of August, and the chairman of the committee will acknowledge to you to-day, as I understand it, that he never consulted other members of the committee at all, and he puts it as the report of the committee—says, "Your committee has carefully considered, and decided," so and so—decided to put before the association again the report which they practically rejected last year.

Again we came here this year. Monday at twelve o'clock noon, is the hour set for considering the bituminous concrete committee report. I am a fairly busy man, but I was here at twelve o'clock Monday noon to discuss that matter with the committee. But the chairman of the committee was not here. Tuesday he arrived, and he very directly gets into communication with me, and asks me what we can do about it. We spent two hours in conference, and we formulated a modification of the Topeka grading, which was just as far as I felt we could properly go and is further than we agreed in the written report to go. Mr. White said the two members of the committee that were here agreed to that definitely, that that was satisfactory. Yesterday morning Mr. White came and said there was a minor point in it about which he had raised a question, regarding whether the products of crusher run would produce a certain specified size. I said I believed that they would, but I hadn't

with me the data from which I could make certain, and telegraphed for it. I received that this morning and I sat right down here and studied it out. We then agreed, and I have it right here, on a slight change. Mr. White and Mr. Kingsley were both there, and we scratched out on a piece of paper—"this is final," subject only to the question of whether one of the graduations should refer to ten-mesh screen or a twenty-mesh screen. That was up to half past eleven this morning. Imagine my surprise, when I walked into this convention at two o'clock, at the hour set for final action, to have the chairman of the committee say, "It is all off. We don't agree."

The minority committee's report, bear in mind, is the report as it was adopted at eleven o'clock this morning by the only two members of the committee who were here—Mr. White and Mr. Kingsley. I hope that it will prevail, and that in the future this association will be put in the position of having adopted as one of its standards a pavement which is laid in three hundred and fifty cities and has been in use for fifteen years, and will adopt as a non-infringement, a specification which is clearly no infringement. Then, if any individual city wants to make any variations, it is free to do so, but it will not be doing so on the responsibility of this Association, which will not put itself in the position of leading cities unwittingly into trouble over the infrigement, thru the guidance of this Association. Mr. Chairman and gentlemen, I thank you.

Mr. Folwell: I do not think there is any misunderstanding, but I would like to have a definite statement, yes or no, whether the specifications are absolutely sure of establishing what we are about. The specification submitted by Mr. Kingsley gave a certain gradation of stone. Do I understand that Mr. Warren will come out with a definite public statement that pavements laid under that specification will not subject a town to infringement?

Mr. Warren: Yes, sir. I gave my word for it. Of course, that is provided that Mr. Kingsley's specification is adopted as a whole, and you adopt bitulithic on the one side and the other as a non-infringing pavement.

Mr. Connell: I just want to let Mr. Folwell know for the second time—I thought I was explicit before—that that specification is already conceded not to be an infringement of the patent.

MR. WARREN: I say it is not an infringement.

MR. WHITE: I arise to a point of privilege. I do not want to take up the time of this convention, but I cannot permit the opportunity to go by to say something about the very unwarranted attack upon the action of this committee. I am not at all surprised that we differed in certain things, but I am surprised that it would develop into what seems to be a personal attack. It is Mr. Warren's business to defend the Warren Brothers Company patent on bitulithic pavement. He is greatly interested in it, and his money is in it. The committee was acting entirely gratuitously; we are all employed in some manner making our living. We cannot devote the time to it that Mr. Warren probably can to his business. The question of whether this committee assembled one day before the convention or not, has nothing to do with it. Mr. Warren's business probably called him here so he could arrange to be here on a certain day, while duty probably kept the committee's members somewhere else. There is no money in this work for the committee, not very much honor, and certainly not much pleasure.

I do not care to go into personalities, but I do want to call your attention to one thing as the vote comes up on this substitute report, and that is this: Personally, and as a member of this Society, I have not the slightest objection to adopting the bitulithic specification as a bitulithic specification. It is the privilege of the Society to do it, but let us not do it under the misapprehension that we are getting something, when we are not getting anything, or that it is a compromise proposition—something given which is beneficial to this Society or beneficial to any corporation that the members of the Society may represent. There is nothing in it, absolutely nothing. The specification as it stands is the Topeka specification, and has been acknowledged as a non-infringing specification; there is nothing in it that goes beyond that. In fact, it does not go quite as far.

If we are going to adopt the bitulithic specification, let us put it up squarely to the Society, and not adopt it under the belief that we are getting something to pay us for doing it. I do not think there is any use of prolonging the discussion further.

MR. CARPENTER: I do not understand that this Society is endeavoring to make any trade, or to get some concession from the Warren Brothers for something it can give them. It seems to me that

we should stand here representing the engineering fraternity, with the backing of this American Society of Municipal Improvements, with all it has accomplished in the past, and try to clear the atmosphere.

Now, as Mr. White says, let us, for the benefit of engineers in general, adopt a specification that is an acknowledged bitulithic specification and which we *shall call* a bitulithic specification, with the distinct understanding that a pavement constructed under it is an infringement. Cities can then use their judgment as to whether they will adopt this specification or some other. Then let us adopt the other specification, which has the assurance of the Warren Brothers that it does not conflict with their patents. It seems to me this is the issue and I do not believe we are here to trade.

Calls for question.

PRESIDENT HOWELL: All in favor of the adoption of Mr. Kingsley's motion will please signify by rising.

A MEMBER: Just what was Mr. Kingsley's motion?

MR. KINGSLEY: As nearly as I can remember it, my motion was that the minority report of the committee as submitted and read in part by Mr. Brown be adopted by the convention as the report of the bituminous paving committee; it was a substitute motion.

The Secretary announced the result of the vote as follows: For the substitute motion, 32; opposed, 21.

PROF. BLANCHARD: As I understand it, we have now only moved to substitute.

MR. KINGSLEY: Mr. President, I am not quite clear on this matter, but I think my motion carried with it the adoption of the substitute report as the report of the committee, did it not?

PRESIDENT HOWELL: That was my understanding of it.

PROF. BLANCHARD: The motion was to substitute your report for the report of the committee, and the adoption of it was moved and seconded. I would ask a ruling on the parliamentary point presented.

If a report is before the house which has been moved to be adopted, and that motion has been seconded, and then a substitute report is presented, should not the first vote be on the substitute motion?

PRESIDENT HOWELL: I guess that is right.

MR. KINGSLEY: If that is the case, then I move, Mr. President, that the report of the committee as substituted by the motion already carried, be adopted as the action of the Society in convention.

Motion seconded.

PROF. BLANCHARD: Mr. Chairman, I do not want to keep a famished multitude here, but there is one thing I wish to call attention to, and that is that there are two parts to this report, one, the adoption of a little modification of the Topeka specification, and the second is this: That you are adopting specifications for bitulithic which are not in accord with the provisions which every committee of this Society has been instructed to follow by the committee on Standard Specifications, and that is, that specifications should be as definite as possible. This specification contains a general description of the bitulithic pavement. It is not, however, along the lines of the specifications which you accept from other committees of this Society. There is nothing in the specification about the mineral aggregate except a description of an aggregate which has that very indefinite quality of inherent stability. If you decide to adopt a specification for the bitulithic pavement, then put in the specification for the mineral aggregate a grading which is as definite as the grading for Topeka and as contained in the specifications for sheet asphalt. Likewise be more definite in regard to the bituminous cement than to say it is to comply with the asphalt specifications of this Society. What does that mean? There are a number of specifications for asphalt cement: one in connection with bituminous macadam pavement, another in connection with bituminous concrete pavement, and another by Mr. Smith's committee on sheet asphalt. Should we jump to the conclusion that any one of the asphalt cement specifications mentioned is the best for bitulithic? I move as an amendment that this report be referred back to the sub-committee on Bituminous Paving with instructions to present at the next convention a report, which will be in accord with the standards required by the Committee on Standard Specifications of every other sub-committee.

MR. CONNELL: Mr. Chairman, I rise to a point of order. It is my understanding that there are several classes of membership in this Society. If this Society adopts this entire report at this session, I submit to you that it is only proper that a roll should be taken of the active members of the Society and they only should determine.

PRESIDENT HOWELL: I cautioned everybody to vote carefully.

MR. CONNELL: I think it is a little out of order to pass upon such an important matter as this by having the people rise or raise their hands, and I think it would be far better for us, altho I know we want to get away from here, to put the whole matter over than to vote and not be sure that we have only the active membership of the Society voting. I will second Mr. Blanchard's motion that the report be referred to the sub-committee for further consideration, and further, that no recommendation be made or any vote taken, that is, a vote of the active membership. That would put the whole matter over for another year, as I see it.

PRESIDENT HOWELL: We have a list of the members here, Mr. Connell. It would not take ten minutes to verify a vote of the active members.

You have heard Mr. Blanchard's motion.

MR. KINGSLEY: There is a motion before the house, Mr. President.

PROF. BLANCHARD: I move this as a substitute motion.

MR. WHITE: The point I wish to make is that this is certainly a very radical departure from any previous method of adopting a specification. This is an engineering society first of all, and certainly we do not want to adopt something here as a precedent that will lead us into we do not know what. The question that Mr. Blanchard raises is certainly a good one. It is certainly not in keeping with the custom of this Society, to adopt a specification in such an indefinite form. I, for one, wish to protest against adopting anything so out of line of all usual procedure. There is a very small attendance—probably not half the number of members that were here earlier in the day. Isn't it worth while to get a representative vote of the Society before we take such radical action?

MR. KINGSLEY: I am very much surprised at Mr. White's statement that this is not a representative attendance, or that it is a small representation. If Mr. White will take the trouble to look over the records of the votes on questions which have been put to the house, where they are counted by this association, or in almost any other association of this character that I know of, I think he will find that the vote which has been announced by the secretary is a pretty large vote. The attendance here this afternoon has been much larger than we usually have at our ordinary sessions, and I feel that this committee ought to feel complimented, to think that the number of active members have stayed here and shown as much real interest in this report and this discussion as they have. I do not believe that there is another committee that has had the attendance and has had the attention that the report and the discussion of these reports have had, and so far as I am concerned, I feel we ought to be proud of the attendance, the attention and the vote that this question has received. I think it is a great deal more than the representative vote.

Calls for question.

MR. WARREN: The question has been raised here that this bitulithic specification is something indefinite, something in the air— don't know what it is. I want to say to you that that is the specification which has been adopted by over three hundred cities in this country as the bitulithic specification; it is the specification for the bitulithic pavement; it is the specification which embodies the best that we know how to produce, and which is as definite as it is practicable to meet all conditions of climate and quality of stones. Furthermore, it is word for word, as I understand it, the specification which the entire membership present of this committee, the sub-committee, presented to your general committee last evening at six o'clock, with its approval.

The chair then put the question on Mr. Blanchard's motion, to refer the minority report back to the sub-committee; a rising vote was taken, resulting as follows: In favor of the substitute motion, 24; opposed 28.

PRESIDENT HOWELL: The substitute motion is lost. Now, the motion of Mr. Kingsley is to adopt the minority report.

A rising vote was then taken on Mr. Kingsley's motion, resulting as follows: For the motion, 32; opposed, 19.

PRESIDENT HOWELL: The motion of Mr. Kingsley, to adopt the minority report, is carried.

The report of the minority of the sub-committee will be found on page 408.

On motion, duly seconded, the convention then adjourned to meet at 9 o'clock p. m.

EVENING SESSION.

The convention was called to order by President Howell at 9 o'clock p. m.

PRESIDENT HOWELL: The first thing on the program this evening is the report of the Committee on Standard Forms, by A. Prescott Folwell, Chairman.

The report will be found on page 379.

On motion of Mr. Potter, duly seconded, the report was adopted.

PRESIDENT HOWELL: We will now hear the report of the Committee on Municipal Legislation and Finance, By Arthur R. Denman, Chairman, of Newark.

The report will be found on page 317.

PRESIDENT HOWELL: We will next take up the paper by Mr. Alexander Potter, "Obligations of the State to the Municipality in Matters of Public Work."

The paper and discussion will be found on page 343.

PRESIDENT HOWELL: The next paper will be, "The Dayton Plan of Government," by Hon. Henry M. Waite, City Manager of Dayton.

The paper and discussion will be found on page 327.

PRESIDENT HOWELL: The next paper is, "Citizen Co-operation in Municipal Affairs" by Mr. J. M. Guild, Secretary of The Greater Dayton Association.

The paper will be found on page 335.

PRESIDENT HOWELL: The next paper is "The Work of the Federated Improvement Associations in Dayton," by William S. Crandall. As he is not here and the paper is in the Advance Papers, we will read it by title.

The paper will be found on page 339.

The next, "The City at Work," is a paper by Mr. L. L. Tribus, Consulting Engineer, New York City.

The paper will be found on page 353.

PRESIDENT HOWELL: We have a few more papers. I would like to get the views of the convention as to whether we want to have them to-night, or have a short session to-morrow morning.

On motion, duly seconded, the convention then adjourned until 9 Friday morning, October 15, 1915.

FRIDAY, OCTOBER 15, 1915.

MORNING SESSION.

The convention was called to order by President Howell at 9:15.

PRESIDENT HOWELL: The first thing on the program this morning will be the report of the Committee on Traffic on Streets, Mr. Louis L. Tribus, Chairman.

The report and discussion will be found on page 283.

PRESIDENT HOWELL: We have three papers which have not been read. The authors have left, and we will read them by title. "Municipal Inspection Methods in the Boro of Manhattan," by Dr. Felix Kleeberg, (*which will be found on page* 264); "The Maintenance of Pavements," by Jacob L. Bauer, County Engineer, Union County, N. J., (*which will be found on page* 256); "Paving Maintenance from the Standpoint of Its Relation to the Economical Features," by Robert A. Meeker, State Engineer of the Department of Public Roads, Trenton, N. J., (*which will be found on page* 261.)

The next paper, printed in the advance papers, is "The Traffic Census and Its Bearing on the Selection of Pavements", by W. W. Crosby, Consulting Engineer, Baltimore, Md. It has been printed in the advance papers, and we will read it by title.

The paper will be found on page 308.

The next paper is the report of Committee on Street Lighting, by James C. Hallock, Chairman, which has not been received. Also, report of Committee on Park Development and Maintenance, by

George A. Parker, Chairman, Hartford, Conn., which has not been received.

The next will be the report of the Committee on Fire Prevention, by Alcide Chausse, Chairman, Montreal, Quebec. The secretary will kindly read it.

SECRETARY BROWN: A part of the report is printed in the advance papers, and will not be read. This is a note by J. C. McCabe, of Detroit, Michigan, who is a member of the Committee on Fire Prevention from Detroit, which has been received since the report was printed.

The report will be found on page 368.

PRESIDENT HOWELL: We will have a paper, which is not on the program, presented by Second Vice-President Sprague on "A Suggested Change of Policy for Maintaining the Pavement in the Railway Area Upon City Streets."

The paper and discussion will be found on page 271.

PRESIDENT HOWELL: All good things come to end, and we are rapidly approaching the close of this convention. That the Dayton Convention has been successful beyond our fondest dreams needs no demonstration. Never before have we had such a large attendance of active and associate members, the total registration of 469, exceeding the Boston attendance by 178. The number of engineers of national reputation attending the various sessions was especially noticeable. Year after year, at the different conventions of this Society, the speaker has looked forward with pleasant anticipation towards meeting some of our loyal members from across the border. The genial Chausse from Montreal; Mr. Charles H. Rust, from Toronto, and that tall, straight, soldierly figure from Hamilton, Ontario, Macallum. Mr. Macallum's influence in this Society has steadily grown. Quiet and rather reserved in manner, we soon found that this modest, unassuming engineer from Canada was an exceedingly well informed man. As President of this Society in 1916, we ask for him that same co-operation from the membership that has been so heartily given to the President about to retire. Mr. Macallum is one of the best equipped men for the presidency of this Society that we have ever had, and we wish him a full measure of

success. Andrew F. Macallum, it gives me great pleasure to place the gavel in your hands.

President elect Macallum takes the chair.

PRESIDENT ELECT MACALLUM: Members of the Society, I wish to thank you very much for having placed me in this position. The Society is growing, as you know, every year. This year we have had a meeting here of nearly five hundred members, coming from all over the country, the representative engineers in municipal work. In our work here, the discussions, as you will notice, were carried on by men who were representative, and men who were known all over the country in their particular lines. Some of these discussions lasted until midnight. Usually, and at most of the meetings, I did a whole lot of talking. This year, I sat down and listened and learned more. I am succeeding some very bright men, and I certainly will do my utmost thruout the year to carry the work forward to such an extent that when we meet at Newark next year, we will try to get as much ahead of this year as we were this year ahead of last.

We have one or two little matters to finish up before the close, and I would ask the secretary to state what he has to present.

SECRETARY BROWN: I want to read into the record the work of the Clearing House this year, so I can use as much as possible to be published. I had an inquiry on oiling roads, which had some interesting replies. There is one on the use of the uniform blanks, which did not have a very satisfactory response. Out of a considerable number of replies, there are only three who say, "Yes". And you will see the length of the list of those who say "No", and of those who did not reply. There is also a question as to what causes asphaltum after being deposited upon a street to crack under the roller. I have perhaps fifteen or twenty answers to that, which seem to give three or four different reasons, sometimes only one of them effective at a time. Here is quite a mass of material on street lighting, some of it which is quite valuable. I have sub-divided it into classifications, and there are a considerable number of forms of report which were asked for, and ordinances and almost anything else that is desired. Of course, it would not be possible to publish anything like all of this in the proceedings, but what I think we can do is to publish a list of the material which I have so it can be on the record, and I will make that note in connection with the publication so that it can be used by any member who would like to have it.

The Executive Committee report has not yet been made. The only matter that needs to be reported was a resolution that only members of the Society can use the specifications. A regulation which was adopted last year was that any city which desired could use the copyrighted specifications by asking for permission. But the idea of the board is that we ought to have something for it, and that if the cities of the United States think enough of us to want to use our specifications, they really ought to carry it a little bit farther, and become members of the association. So I was instructed in case any city or county official wants to use the specifications to say we would be very glad to have them do so and give them permission, if they are members of the association.

We had a letter from the United States Forest Products Laboratory at Madison, Wisconsin, asking for assistance in keeping records on wood block pavement as follows:

This laboratory is considering the advisability of undertaking the task of keeping a record of every wood-block pavement in the United States upon which reliable data can be obtained. In general, the plan under consideration is to interest as many engineers as possible in the project and get them to co-operate with us by furnishing data each year upon the wood-block pavements under their supervision or observation. These data would be entered by them in duplicate upon cards prepared for the purpose, one card to be sent to the Forest Products Laboratory, where it would be kept in the central file, and the other to be retained by the engineer making the report. At the end of each year the data obtained during the year would be tabulated and such conclusions drawn as would appear justified from the records. This tabulated report would then be published in the proceedings of some interested association and enough reprints obtained to furnish each co-operator with a copy. I believe in this way a very valuable record could be built up which would become of increasing use to everyone interested in wood-block pavement. I should like very much to have your ideas as to the feasibility of this plan and any suggestions you may be able to make concerning the best way in which it can be carried out. I would appreciate it also if the plan could be taken up with the executive committee of your association so that we might learn

their opinions as to the advisability and feasibility of the plan and the extent to which we could expect co-operation from the association.

GEO. M. HUNT,
Acting in Charge, Section of Wood Preservation.

Quite a number of new members have been voted upon.

The list will be found at the end of the Secretary's report on page 486.

There are a number of applications which have come in since the board meeting, which will doubtless be elected, and I will read them as tho they were.

This list is on page 487.

MR. FOLWELL: I just want to ask whether the secretary did not intend in making that previous statement to say, not that the specifications may be used only when the city was a member, but if a representative of the city was a member.

SECRETARY BROWN: Yes, I think it would not make any difference if the city was a member, or if it had a representative in the membership.

The Finance Committee has made its report.

REPORT OF FINANCE COMMITTEE.

To the Executive Committee,
American Society Municipal Improvements:

Acting as your Finance Committee, we beg to report that we have examined the accounts of the Secretary and Treasurer. We find the same correct, as reported. The balance on the books to the credit of the Association and accounted for October 1, 1915, is $1,480.29.

Finance Committee.
R. Keith Compton,
F. J. Cellarius.

PRESIDENT-ELECT MACALLUM: We have heard the report of the Finance Committee read by the Secretary and audited by two members. What is your pleasure?

On motion, duly seconded, the report of the Finance Committee was accepted.

SECRETARY BROWN: Here is the Resolutions Committee report, signed by Messrs. Briggs, Sprague and Preston.

RESOLVED, That the American Society of Municipal Improvements extend to The Greater Dayton Association, the local committee on convention arrangements, the city officials, the Engineers' Club and the local Ladies' Committee, their sincere appreciation and thanks for the splendid manner in which this society, their friends and guests have been entertained and for their untiring, devoted and successful efforts in making this 22nd Convention one of the best ever held by this Society.

RESOLVED, That the American Society of Municipal Improvements extend to the President, officers and members of the National Paving Brick Manufacturers' Association their very cordial thanks for the banquet and entertainment tendered to this Society on Tuesday evening, October 12th.

B. E. Briggs,
N. S. Sprague,
J. M. Preston.

MR. TRIBUS: I move its adoption.

The motion was seconded by Mr. Fisher and carried by rising vote.

MR. TRIBUS: I think most of us have noticed as we work in different organizations that the greatest satisfaction, and perhaps in some respects the only recognition received, is from the personal feeling of accomplishment, not always accomplishment according to our desires, but accomplishment according to our best efforts. And it falls to the lot of some to actually see something done that is worth doing. I think this Society in its twenty-two years of existence has seen something done worth doing. It has seen officers come and go who have been faithful, who have been eneregtic, who have been helpful, who have been respected. I do not wish to take

much time, but I think that I express the feeling of each one here and of those who have not been able to remain with us to the end, a feeling that our retiring president will certainly have the consciousness in himself of having done a good job well, and it is a pleasure to me to be able to express to him in their behalf, our gratification, respect, friendship, and thanks for his accomplishments, for his loyalty, for his helpfulness, with the wish that for a great many years to come he may be with us and of us; and to the other officers also, our appreciation of their efforts. Tho "the king is dead, long live the king," is the old motto, we shall never forget those who have been earnest helpers in the past, with special thanks to our retiring president, Mr. Howell. (Applause.)

EX-PRESIDENT HOWELL: Mr. Tribus, I thank you for your very kind remarks. All I can say is I did the best I knew how.

PRESIDENT-ELECT MACALLUM: As there is nothing more before this convention, we will adjourn until our meeting in Newark, next year.

Adjournment.

ATTENDANCE AT CONVENTION.
DAYTON, OHIO.

Harvey C. Adams
A. J. Aitken
H. W. Alden
Wm. Alderman
E. C. Aldrich
Mr. and Mrs. F. R. Allen
K. B. Allen
W. A. Alsdorf
Jno. W. Alvord
L. A. Amsden
G. A. Anderson
L. E. Anderson
A. F. Armstrong
J. H. Arnold
G. F. Atkins
H. S. Atkinson
Atlantic Refining Co., Mgr.
Joshua Atwood

Mr. and Mrs. Ril T. Baker
Wm. D. Baker
J. G. Barbour
Jas. E. Barlow
W. R. Barnhart, Jr.
C. C. Barr
Jos. P. Bayne
Luther Beard
Henry J. Beck
J. L. Beggs
Philip Bell
W. H. Bell
Wm. S. Belt
Robert Berner
A. S. Bickham
Mr. and Mrs. E. G. Biechler
J. E. Bierer
Albert Biertuempfel
W. H. Bitzer
W. T. Blackburn
C. C. Blair
Mr. and Mrs. Will P. Blair
A. H. Blanchard
F. W. Blauenschein
J. B. Blunk
A. P. Bookwalter
Geo. Borden
A. C. Boughton
A. R. Boudinot

D. C. Bow
F. C. Bowman
Wm. D. Boyd
R. H. Boynton
M. F. Bramley
Mr. and Mrs. W. W. Brandon
T. H. Brannan
H. L. Brehm
J. C. Brennock
B. E. Briggs
T. Brindle
Benjamin Brooks
Charles C. Brown
Matthew Brown
C. H. Bryson
F. A. Bumbarger
Mrs. Chas. J. Buntell
Ray W. Burks

Wallace L. Caldwell
F. W. Cappelen
G. E. Carlyle
Geo. A. Carpenter
Zenas W. Carter
Ray N. Case
F. J. Cellarius
J. D. Ceti
W. T. Challar
Fred R. Charles
Alcide Chaussé
Frank W. Cherrington
J. B. Chittenden, Jr.
E. H. Christ
S. R. Church
F. A. Churchill
G. L. Clapper
Mr. and Mrs. F. H. Clark
J. D. Clark
J. O. F. Clark, Jr.
F. O. Clements
M. T. Coakley
George R. Collins
R. Keith Compton
Mr. and Mrs. J. E. Conley
Wm. H. Connell
A. W. Copley
Douglas Cornell
S. Cameron Corson

Jas. M. Cox
Jno. S. Crandall
W. S. Crandall
Wm. L. Craven, Jr.
H. H. Craver
W. W. Crosby
O. L. Culley
Gaylord C. Cummin
L. D. Cutcheon
Frank G. Cutter

E. L. Dalton
R. H. Danforth
M. DeBerard
Chas. G. Deckman
Chas. J. Deckman
Arthur R. Denman
C. W. Denniston
E. J. Dewine
C. A. Divine
W. W. Dixon
Fred W. Donahoe
A. W. Dow
Edward Dow
J. R. Draney
A. D. Duck
D. E. Dunham
F. B. Dunn
Henry W. Durham
E. G. Durst
Spencer M. Duty

T. W. Eastman
Harrison P. Eddy
D. L. Edwards
F. O. Eichelberger
Gilbert C. Eichelberger
J. W. Eichelberger
L. W. Eighmy
Carl E. Ekstrand
Frank A. Elliott
E. W. Ellis
Mr. and Mrs. Frederick T. Elwood
J. C. Ely
J. S. Ervin

E. A. Fisher
M. A. Fisher
T. P. Fitzgerald
Herbert E. Fletcher
A. Prescott Folwell
J. D. Forrester
E. P. Foster
G. H. Francis

Chas. H. Frank
A. B. French
G. O. French
Elmo A. Funk

B. J. Gallagher
M. A. Gantz
D. F. Garland
Louis W. Gay
J. A. Gehres
Geo. H. Gengnagel
C. E. Gerard
T. A. Giberson
David B. Gibson
Fred Giddings
H. J. Gillum
Jno. Glass
R. M. Graham
Mr. and Mrs. B. F. Granger
Maurice B. Greenough
Chas. Grover
J. M. Guild

L. Haigh
S. C. Haines
F. P. Hamilton
H. P. Hank
Mr. and Mrs. H. F. Harris
J. C. Harris
J. B. Harshman
L. C. Hatch
T. Chalkley Hatton
S. J. Hawley
A. B. Hays
J. S. Helm
W. L. Hempelmann
C. U. Hendershot
Rudolph Hering
Dr. H. H. Herman
E. L. Hess
E. J. Higgins
Herbert V. Hildreth
Mr. and Mrs. Jno. B. Hittell
W. A. Hogue
Clifton Hollihan
Edgar M. Hoopes, Jr.
F. L. Hopley
J. Merrick Horn
J. T. Hornbeck
W. W. Horner
J. W. Howard
Mr. and Mrs. Will B. Howe
Miss Howe
Carl L. Howell
Wm. A. Howell

S. W. Hume
R. C. Huston

G. M. Ingram

P. H. Jandernal
F. W. Jennings
C. L. Johnson
M. S. Jordan
Robert June

F. R. Kanengeiser
P. S. Kaull
H. S. Keck
Julian Kendrick
D. A. Kennedy
J. C. Kennedy
Wm. J. Kernan
W. H. Kershaw
T. W. Kilby
E. A. Kingsley
L. Kirschbraun
Felix Kleeberg
A. B. Kline
Chas. H. Kline
J. C. Kline
Robt. E. Kline
S. D. Knight
J. H. Knowlton
Walter S. Krider

F. C. Laberge
Mr. and Mrs. Thos. Lahey
Geo. W. Lamson
E. A. Lawrence
Jno. Laylin
Henry G. Lehrbach
A. Lenderink
Jos. Leopold
H. E. Lersch
H. Levinson
R. J. Lewis
Chas. P. Light
Mr. and Mrs. Henry D. Lindsley
J. B. Linn
Chas. W. Linsley
Henry S. Lofquist
G. W. Lothrop
Wm. H. Luchtenberg
A. B. Luten
D. R. Lyman
J. Horace Lytle

Andrew F. Macallum
H. H. MacDonald
Henry Maetzel
Wm. F. Mallon
F. L. Manning
Jas. R. Marker
W. J. Marks
C. C. Marshall
Chas. Marshall
W. G. Martens
H. P. Martin
Miss Mase
T. C. Mayer
T. J. McCormick
Jno. A. McGee
Geo. B. McGrath
O. C. McLaughlin
Donald McNeil
W. A. Meddick
E. J. Mehren
A. J. Mendenhall
E. W. Mentel
B. B. Meriwether
Coleman Meriwether
L. V. Metz
E. L. Middleton
B. F. Miller, Jr.
C. H. Miller
J. S. Miller, Jr.
Herbert C. Moats
Arthur E. Morgan
G. D. Morris
M. M. Morrow
E. A. Morse
H. S. Morse
Hal Moseley
G. R. Muramo
S. R. Murray
J. L. Murphy
M. D. Murphy
T. F. Murphy
G. W. Myers

W. P. Near
Robert R. Nevin
W. T. Newcomb
J. P. Newman
Mr. & Mrs. J. B. Nicholson
Geo. H. Norton
H. C. Nutting

G. W. Nushaw
W. H. Parks
L. R. Parmelee
F. W. Patterson
J. R. Paul
Lyle Payton

Wm. C. Perkins
Frank W. Pierson
S. G. Pollard
Clarence D. Pollock
Alexander Potter
J. M. Preston
H. B. Pullar

Jno. H. Qualman

N. C. Ralph
J. E. Ramsay
T. A. Randall
Edw. S. Rankin
F. L. Raschig
C. A. Raymond
G. M. Raymond
D. E. Reagan
F. Reich
P. C. Reilly
Hugo Reid
Wm. A. Reid
F. A. Reimer
H. S. Renkert
O. W. Renkert
C. M. Reppert
F. H. Rike
J. W. Robb
E. M. Robinson
N. C. Rockwood
Mr. and Mrs. C. Harry Rogers
F. R. Root
J. E. Root
H. H. Rosenberg
Edw. Rossiter
C. E. Rowe
I. R. Rowland
Chas. A. Rudolph
Raymond Russell
John Ryan
P. H. Ryan

S. Sammelman
R. W. Sanders
Edw. C. Sargent
W. F. Sargent
W. E. Sarver
J. Edw. Sauer
Chas. W. Schaeffer
E. B. Schmidt
H. H. Schmidt
Wm. P. Schoonover
Adam Schwerin
H. E. Scott
P. P. Sharples
Morris R. Sherrerd
Wade W. Shidler
G. N. Shroyer
J. W. Sibley
Jno. N. Simpson
Neil B. Sinclair
W. E. Sizzad
Adolph W. Smith
Fowler L. Smith
Fred C. Smith
F. P. Smith
Geo. B. Smith
Gordon Smith
Victor C. Smith
Geo. W. Sparks
Herbert Spencer
N. S. Sprague
L. R. Statler
Geo. D. Steele
Eugene W. Stern
Wm. H. Stone
C. L. Storm
F. L. Stowell
R. T. Stull
Superior Portland Cement Co.
Mr. and Mrs. E. W. Sylvester
Mr. and Mrs. R. G. Sykes

H. M. Talbott
K. H. Talbot
Jesse Taylor
W. C. Taylor
W. H. Taylor, Jr.
Geo. O. Tenney
H. M. Terrell
W. O. Thompson
Frank T. Townsend
O. N. Townsend
Wm. O. Tracy
N. V. Trautman
L. L. Tribus
Wm. Tries, Jr.
Walter E. Tyler

I. F. Underwood

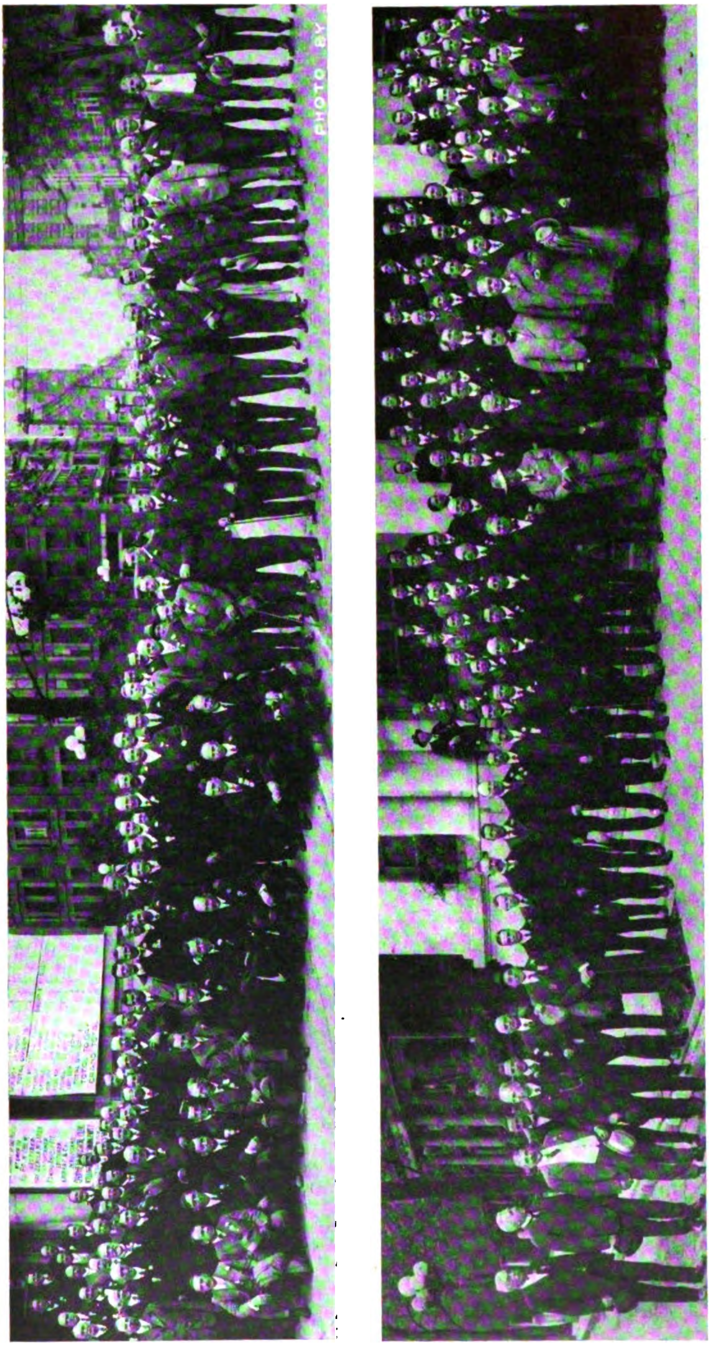
J. R. Valk
Jas. H. Van Busen
J. A. Vandewater
Isaac Van Trump
F. J. Van Zuben
Hermann von Schrenk

H. O. Wait
H. M. Waite

R. C. Wallis
Jas. T. Ware
Geo. W. Warmott
Geo. C. Warren
Robt. M. Watson
Wm. Wengle
C. J. Wetzel
Linn White
W. J. Whitworth
H. C. Wight
Frank L. Wilcox
F. R. Williams
J. D. Williams
T. M. Wilson
Colin R. Wise
J. M. Woodruff
S. M. Woodward
W. Thos. Wooley
R. A. Worthington

Jas. H. Young

T. Zartman



IN ATTENDANCE AT CONVENTION.

OFFICERS OF THE SOCIETY FOR THE YEAR 1915-1916

President ....A. F. MACALLUM.....Hamilton, Ont.
First Vice-President ..NORMAN S. SPRAGUE.Pittsburg, Pa.
Second Vice-President.JOHN B. HITTELL....Chicago, Ill.
Third Vice-President.E. R. CONANT........Savannah, Ga.
Secretary ....CHARLES C. BROWN. Indianapolis, Ind.
Treasurer ....WILL B. HOWE ......Concord, N. H.

Finance Committee.

EDWARD S. RANKIN, Chairman .....Newark, N. J.
MATTHEW BROWN ....Emporia, Kans.
F. J. CELLARIUS ....Dayton, O.

Executive Committee.

The officers of this Society, together with the Past Presidents who have retained their continuous membership, constitute the Executive Committee. The Past Presidents are as follows:

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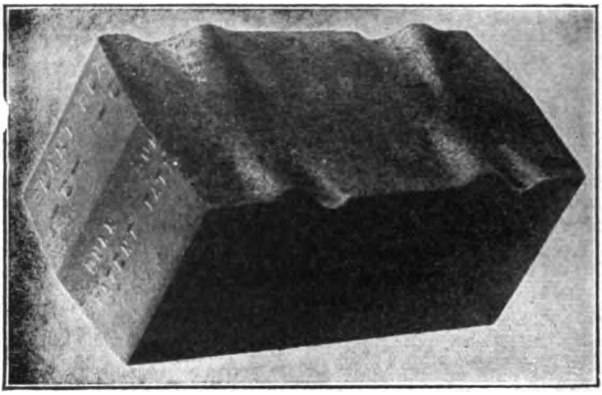

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First Annual Convention	1894	Buffalo, N. Y.
Second Annual Convention	1895	Cincinnati, Ohio.
Third Annual Convention	1896	Chicago, Ill.
Fourth Annual Convention	1897	Nashville, Tenn.
Fifth Annual Convention	1898	Washington, D. C.
Sixth Annual Convention	1899	Toronto, Canada.
Seventh Annual Convention	1900	Milwaukee, Wis.
Eighth Annual Convention	1901	Niagara Falls, N. Y.
Ninth Annual Convention	1902	Rochester, N. Y.
Tenth Annual Convention	1903	Indianapolis, Ind.
Eleventh Annual Convention	1904	St. Louis, Mo.
Twelfth Annual Convention	1905	Montreal, Canada.
Thirteenth Annual Convention	1906	Birmingham, Ala.
Fourteenth Annual Convention	1907	Detroit, Mich.
Fifteenth Annual Convention	1908	Atlantic City, N. J.
Sixteenth Annual Convention	1909	Little Rock, Ark.
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Nineteenth Annual Convention	1912	Dallas, Texas.
Twentieth Annual Convention	1913	Wilmington, Del.
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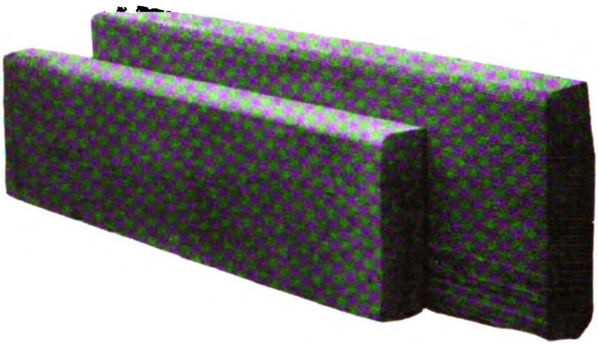

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